

NC STATE UNIVERSITY

2001

GRADUATE

Catalog

This catalog is intended for informational purposes only. Requirements, rules, procedures, courses and informational statements set forth herein are subject to change. Notice of changes will be conveyed to duly enrolled students and other appropriate persons at the time such changes are effected.

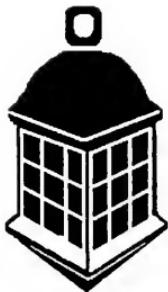
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THE
GRADUATE
SCHOOL

Graduate Catalog



North Carolina State University
Raleigh, North Carolina

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NORTH CAROLINA STATE UNIVERSITY

North Carolina State University (NC State) is a national center for research, teaching and extension, and its graduate education has stood for quality for more than a century. As a Land-Grant state university, it shares the distinctive characteristics of these institutions nationally--broad academic offerings, extensive public service, national and international activities, and large-scale extension and research programs.

Faculty

NC State's faculty are the foundation for the university's academic strength with the more 2,000 Graduate Faculty being based in the university's ten colleges and the Graduate School. The colleges are Agriculture and Life Sciences, Design, Education, Engineering, Natural Resources, Humanities and Social Sciences, Management, Physical and Mathematical Sciences, Textile and Veterinary Medicine. Innovators, fine mentors and nationally respected leaders in their fields, the faculty have won significant research grants and maintain an impressive record of publication. In the 1999-2000 academic year, they attracted more than \$133 million in externally funded grant and contract support.

Twenty faculty are members of the National Academy of Science or National Academy of Engineering. Others are Guggenheim and Fulbright Fellows; winners of Presidential awards for Young Investigators and for Excellence in Science, Mathematics and Engineering Mentoring; and recipients of prestigious honors in their fields.

The open academic atmosphere at NC State makes for a vital exchange of ideas between graduate students and faculty who are dedicated to their roles as mentors. Typical graduate academic environments involve small groups, while students and faculty often work in solo mentor-protégé relationships.

Students

The more than 5,000 master's and doctoral students enrolled at NC State reflect the richness and diversity energizing the university community and come from 49 states and 76 different countries. In numbers of graduates, NC State is one of America's top forty doctorate-granting institutions according to the National Opinion Research Center Survey of Earned Doctorates. In 1999-2000, 1,168 men and women earned master's degrees while 317 earned doctoral degrees. The university takes pride in its record for rapid doctoral time-to-degree, especially given the rigor of these programs.

Graduate students play important roles in the dynamic research environment by engaging in research within traditional disciplines and as members of interdisciplinary teams, and working alongside faculty, they make vital contributions to investigations with regional, national and international impact. Basic and applied research takes place in state-of-the-art facilities, including more than four dozen specialized research centers, while the NC State Libraries rank among the nation's top 50 university libraries. Faculty and students also work closely with leading-edge corporations and research centers on Centennial campus and in nearby Research Triangle Park, including the North Carolina Supercomputing Center, the Research Triangle Institute and the North Carolina Biotechnology Center.

Accreditation

NC State is a member of the National Association of State Universities and Land-Grant Colleges. It is also a member of the American Council on Education, the College Entrance Examination Board, the Council of Graduate Schools, the National Commission on Accrediting and the Southern Association of Colleges and Schools.

NC State is accredited by the Commission on Colleges of the Southern Association of Colleges and Schools to award the associate, baccalaureate, master's and doctoral degrees. Numerous professional fields are also accredited by national accrediting agencies.

ADMINISTRATION

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A. Blanton Godfrey, *Dean, Textiles*

Oscar J. Fletcher, *Dean, Veterinary Medicine*

Graduate School--Administrative Office

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Margaret F. King, *Associate Vice Chancellor and Senior Associate Dean*

Rebeca C. Rufty, *Associate Dean*

Duane K. Larick, *Assistant Dean*

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Mission of North Carolina State University

The unique mission of North Carolina State University is to serve the citizens of North Carolina as the state's only research university in the land-grant tradition. Since its founding in 1887, NC State has been committed to science and technology as pathways to human betterment and has served as an innovative educational resource, providing leadership for positive intellectual, social, and technological change. Faithful to its founding mission, the University must now meet the challenges posed by the increasing complexity of our global society and the accelerated growth in knowledge and technology. At the same time, it must continually address the effects of these developments on the environment and on the social and economic well-being of the people of North Carolina, the nation, and the world. Spurred by these new challenges, NC State will continue to fulfill its mission through the integrated functions of teaching, research, and extension, its unique form of public service.

Teaching, research, and public service will continue to be mutually enriching enterprises at NC State. The activities of research and extension interact to provide students with an environment for learning that stresses creativity, problem solving, social responsibility, and respect for human diversity. The educational and extension functions join to apply, test, and disseminate the new knowledge generated by research.

During the University's first hundred years, its distinctive mandate has led to preeminence in science, technology, and engineering. This mandate will continue to shape future development, necessitating excellence in the full spectrum of disciplines that provide the intellectual and critical foundations for understanding, anticipating, and responding to public needs.

Undergraduate education is a major responsibility of NC State. Core education is provided in science and the humanities, with specializations offered in physical, social, and life sciences, in the humanities, and in professional and technical disciplines. The atmosphere of a research university provides distinctive opportunities for undergraduates to benefit from the experience of research in the classroom, laboratory, and informal settings. Exposure to the discovery and synthesis of new information provides students with a basis for identifying and solving society's problems and builds a critical foundation for their personal growth, cultural enrichment, and professional development.

As a national center for doctoral studies, NC State embraces the responsibility to maintain excellence in graduate research and education. Students work as partners with faculty in the creation, expansion, conservation, and transmission of knowledge. Graduate education will continue to evolve as the University builds on its traditional and preeminent strengths in science, technology, and engineering and as it develops further strengths in complementary disciplines.

Research and scholarly inquiry form the foundation for education and public service at NC State. Faculty and students in all disciplines engage in the art and science of discovery in a climate of free inquiry and creativity, extending the boundaries of knowledge and horizons of human intellect. The research mandate of NC State is signified in its national classification as a Research University - Extensive.

The University's land-grant philosophy is manifest in its commitment to active stewardship of the human and natural resources of the state. NC State has been an integral part of significant economic and technological changes in North Carolina for the past one hundred years. This stewardship is expressed currently through public service activities in all the University's colleges and schools, whereby the expertise resident among the faculty and students is disseminated across the state through extension, technical assistance, professional development, lifelong education, and technology transfer programs. Loyal to the vision of its founders in the nineteenth century, NC State will continue to strive through extension and public service to improve the quality of life for North Carolinians into the twenty-first century.

NC State's dual designations as land-grant university and a Research University - Extensive form the basis for the unique role of NC State in The University of North Carolina. NC State enters a new century with deep appreciation for the significance of these mandates and the commitment to excellence and change that they jointly require.

Accreditation by the Southern Association of Colleges and Schools

NC State is accredited by the Commission on Colleges of the Southern Association of Colleges and Schools to award the associate, baccalaureate, master's and doctoral degrees.

Nondiscrimination Statement

Equal Opportunity and Non-Discrimination

It is the policy of the State of North Carolina to provide equality of opportunity in education and employment for all students and employees. Accordingly, the university does not practice or condone unlawful discrimination in any form against students, employees or applicants on the grounds of race, color, religion, sex, national origin, age, disability or veteran status. It is the internal policy of North Carolina State University to prohibit discrimination on the basis of sexual orientation. Retaliation against any person complaining of discrimination is in violation of federal and state law and North Carolina State University policy, and will not be tolerated.

Unlawful Harassment

Harassment based upon race, color, religion, creed, sex, national origin, age or disability is a form of discrimination in violation of federal and state law and North Carolina State University policy and will not be tolerated. It is the internal policy of North Carolina State University to prohibit harassment on the basis of sexual orientation. Retaliation against any person complaining of harassment is in violation of federal and state law and North Carolina State University policy, and will not be tolerated. North Carolina State University will respond promptly to all complaints of harassment and retaliation. Violation of this policy can result in serious disciplinary action up to and including expulsion for students or discharge for employees.

Every individual is encouraged, and should feel free, to seek assistance, information and guidance from his/her supervisor, the Office for Equal Opportunity, the Office of Student Conduct or the Employees Relations section of Human Resources.

For additional information, contact:

Office for Equal Opportunity
Box 7530
North Carolina State University
Raleigh, NC 27695-7530
Phone: (919) 515-1329 or 515-3148

Disability Services for Students

Students desiring reasonable accommodations for their documented disability should contact Disability Services for Students (DSS), Suite 1900, Student Health Center, 2815 Cates Avenue, (919) 515-7653 (Voice), (919) 515-8829 (TTY). Services and accommodations are provided based on the student's documented needs and are determined in consultation with the student and his/her DSS service provider. Such requests should be made far in advance of registration deadlines to ensure timely services and accommodations. All contact with DSS personnel is held in the strictest of confidence, and information is released only with the student's permission.

Code of Student Conduct

North Carolina State University is committed to academic integrity, and all students are required to adhere to the NC State Code of Student Conduct.

Additional Information

If additional information is needed, contact the Graduate School, 106 Peele Hall, P. O. Box 7102, North Carolina State University, Raleigh, N.C. 27695-7102 (telephone 919/515-2871).

THE GRADUATE SCHOOL

Graduate instruction was first offered at North Carolina State University in 1893, and the first doctoral degree was conferred in 1926. In the ensuing years, the Graduate School has grown steadily and now provides instruction and facilities for advanced study and research in the fields of agriculture and life sciences, design, education, engineering, natural resources, humanities and social sciences, management, physical and mathematical sciences, textiles and veterinary medicine.

The Graduate School is currently composed of more than 2,000 graduate faculty members. Educated at major universities throughout the world and established both in advanced teaching and research, these scholars guide the University's 6,000 master's and doctoral students from all areas of the U.S. and many other countries.

The faculty and students have available exceptional facilities, including libraries, laboratories, modern equipment and special research areas. Additionally, a cooperative agreement exists among the Graduate Schools of the University of North Carolina at Chapel Hill, the University of North Carolina at Greensboro, Duke University and North Carolina State University which increases the educational and research possibilities associated with each.

Graduate School--Administrative Office

Robert S. Sowell, Dean

Margaret F. King, Associate Vice Chancellor and Senior Associate Dean

Rebeca C. Rufty, Associate Dean

Duane K. Larick, Assistant Dean

Administrative Board of the Graduate School

Term Expires

R. S. Sowell, Dean

M. F. King, Senior Associate Dean

R. C. Rufty, Associate Dean

D. K. Larick, Assistant Dean

D. H. Akroyd, Associate Professor of Adult and Community College Education June, 2003

G. T. Barthalmus Professor of Zoology; Associate Dean and Director of Academic Programs, College of Agriculture and Life Sciences June, 2003

S. M. Bedair, Professor of Electrical and Computer Engineering, College of Engineering December, 2001

B. J. Fox, Professor of Curriculum and Instruction June, 2004

J. E. Gadsby, Associate Professor of Anatomy, Physiological Sciences and Radiology December, 2004

J. G. Gilligan, <i>Professor of Nuclear Engineering; Associate Dean for Academic Affairs, College of Engineering</i>	June, 2002
C. R. Knoeber, <i>Professor of Economics</i>	April, 2001
C. E. Knowles, <i>Professor of Marine, Earth and Atmospheric Sciences; Interim Associate Dean, Physical and Mathematical Sciences</i>	June, 2002
R. C. Long, <i>Professor of Crop Science</i>	June, 2003
C. R. Miller, <i>Professor of English</i>	February, 2001
G. E. Mitchell, <i>Professor of Physics</i>	July, 2001
Elizabeth O'Sullivan, <i>Associate Professor of Political Science and Public Administration; Director of Graduate Programs, Public Administration</i>	April, 2005
W. Oxenham, <i>Professor of Textile and Apparel, Technology and Management; Associate Head and Director of Graduate Programs</i>	August, 2002
S. R. Raval, <i>Associate Professor of Landscape Architecture</i>	August, 2003
B. E. Wilson, <i>Associate Professor of Parks, Recreation and Tourism Management and Director of Graduate Programs</i>	June, 2003

THE CALENDAR

This calendar is subject to periodic review and revision. Please check with the University Registrar and/or the Graduate School to determine if changes have been made.

SUMMER SESSIONS, 2001

First Session

May 23	Wed	First day of classes
May 24	Thurs	Last day to add a course without permission of instructor
May 28	Mon	Last day to register (includes payment of tuition and fees) or to add a course. Last day to withdraw or drop a course with a refund. (NOTE: The tuition and fees charge is based on the official number of hours and courses carried at 5:00 p.m. on this day.) TRACS closes at 5:00 p.m. (After this day, drops processed in 1000 Harris Hall)
June 1	Fri	Departmental recommendations for US citizen applicants for Second Summer Session 2001 due in Graduate Admissions Office
		Electronic Thesis and Dissertation Workshop
June 6	Wed	Last day to withdraw or drop a course without a grade at the 400 level or below. Last day to change from credit to audit at the 400 level or below
June 8	Fri	Last day to withdraw or drop a course without a grade at the 500-800 level. Last day to change from credit to audit at the 500-800 level
June 25	Mon	Graduate Admission application deadline for US citizen applicants for Fall 2001
June 26	Tues	Last day of classes
June 27	Wed	Reading Day
June 28-29	Thurs-Fri	Final examinations

Second Session

July 5	Thurs	First day of classes
July 6	Fri	Last day to add a course without permission of instructor
July 10	Tues	Last day to register (includes payment of tuition and fees) or to add a course. Last day to withdraw or drop a course with a refund. (NOTE: The tuition and fees charge is based on the official number of hours and courses carried at 5:00 p.m. on this day.) TRACS closes at 5:00 p.m. (After this day, drops processed in 1000 Harris Hall)

July 11	Wed	<i>Deadline for submission of theses and dissertations to the Graduate School, in final form as approved by advisory committees, by candidates for master's and doctoral degrees in August, 2001. Last day for unconditional pass on final oral examinations by candidates for master's degrees not requiring theses.</i>
July 16	Mon	Departmental recommendations for US citizen applicants for Fall 2001 semester due in Graduate Admissions Office
July 19	Thurs	Last day to withdraw or drop a course without a grade at the 400 level or below. Last day to change from credit to audit at the 400 level or below
July 20	Fri	Last day to withdraw or drop a course without a grade at the 500-800 level. Last day to change from credit to audit at the 500-800 level
August 8	Wed	Last day of classes
August 9-10	Thurs-Fri	Final examinations
August 10	Fri	Summer Graduation (no commencement program)

FALL SEMESTER, 2001

August 20	Mon	First day of classes
Sept. 3	Mon	Holiday (Labor Day)
Sept. 28	Fri	Electronic Thesis and Dissertation Workshop
October 12	Fri	Fall vacation begins at 10:20 p.m.
October 16	Wed	Classes resume at 8:05 a.m.; 8:35 a.m., Centennial Campus
November 9	Fri	<i>Deadline for submission of theses and dissertations to the Graduate School, in final form as approved by advisory committees, by candidates for master's and doctoral degrees in December, 2001. Last day for unconditional pass on final oral examinations by candidates for master's degrees not requiring theses.</i>
November 21	Wed	Thanksgiving vacation begins at 1:15 p.m.
November 26	Mon	Classes resume at 8:05 a.m.; 8:35 a.m., Centennial Campus
December 7	Fri	Last day of classes
Dec. 10-18	Mon-Tues	Final examinations
December 19	Wed	Fall Graduation Exercise

SPRING SEMESTER, 2002

January 7	Mon	First day of classes
January 21-22	Mon-Tues	Holiday (Martin Luther King Jr. Day)
March 8	Fri	Spring vacation begins at 10:20 p.m.
March	Mon	Classes resume at 8:05 a.m.; 8:35 a.m., Centennial Campus

April 5	Fri	Deadline for submission of theses or dissertations to the Graduate School, in final form as approved by advisory committees, by candidates for master's and doctoral degrees in May, 2002 <u>Last day for unconditional pass on final oral examinations by candidates for master's degrees not requiring theses.</u>
March 29	Fri	Holiday (Good Friday)
May 3	Fri	Last day of classes
May 6-14	Mon-Tues	Final examinations
May 18	Sat	Spring Commencement

Drop Dates for Minicourses

The drop date for a five-week minicourse is the last day of the third week of the minicourse. The drop date for a seven-week minicourse is the last day of the fourth week of the minicourse.

University Graduate Student Association

The University Graduate Student Association (UGSA) is an academic, political and social organization comprising all graduate students. It is governed by elected officers and representatives from departmental GSA chapters. Officially recognized by the university as the voice of graduate students, it provides graduate student representation on various university committees. The UGSA President has full voting membership on the Administrative Board of the Graduate School and meets regularly with other university officials, including the Dean of the Graduate School and the Chancellor of NC State.

Some services provided by the UGSA include travel reimbursement for presenting original research at professional conferences, graduate student orientation, a teaching effectiveness workshop and outstanding TA awards, cash rebates to departmental chapters and assistance with electronic communications among NC State graduate students.

The graduate student experience is filled with both opportunities and possibilities. As is the case with most graduate students, the schedule is challenging and time consuming, thus, finding time to explore the vast resources of NC State can be difficult. The UGSA was established with the intent to solve this problem by making the graduate experience both fruitful and more comfortable through access to the knowledge of experienced UGSA members.

The UGSA can provide answers to questions regarding graduate student life and may be contacted via departmental representatives or the UGSA president, whose telephone number can be obtained from the Graduate School. Students may also visit the UGSA homepage embedded in the Graduate School's homepage on the World Wide Web. All graduate students are invited to attend the monthly meetings and become involved with the UGSA.

GENERAL ADMISSIONS INFORMATION

Application

Applications for admission must be accompanied by the following: two official transcripts from all colleges and universities previously attended, references from at least three people who know of the student's academic record and potential for graduate study, a non-refundable application fee of \$55.00 for US Citizens and Permanent Residents or \$65.00 for Non-Resident Aliens (Internationals) and, in most cases, an official statement of the student's Graduate Record Examination or other standardized test scores. Application and reference forms may be obtained by writing or visiting the Graduate School, 106 Peele Hall, Box 7102, North Carolina State University, Raleigh, NC 27695-7102. When completed, all application materials should be returned according to instructions. Application is made for a specific degree program and date of enrollment (see Admissions).

International Students

Students whose native language is other than English, regardless of citizenship, must submit TOEFL (Test of English as a Foreign Language) scores as evidence of ability to use English at a level of competence sufficient for graduate work. The minimum requirement for admission is a TOEFL score of 213 on the computer-based test, with at least 17 on two of the three sections and no section score below 13. For students taking the paper-based TOEFL, the minimum requirement for admission is an overall score of 550, with scores of 50 on at least two of the sections and no section score below 45. (Minimum score subject to change; departments may establish a higher minimum requirement.) The test date must be within 24 months of the application deadline date before the semester for which the application is being reviewed. An official score report issued by the Educational Testing Service is required. The international applicant must provide the University with verification that the required funds are available to support the proposed program of advanced study. Foreign nationals in the United States at the time application is made must also provide information regarding their current visa status. The University provides special forms to be used by the applicant in supplying this information.

Admission

The procedures followed in evaluating an applicant's potential for success in graduate work and the criteria used for admissions decisions vary according to programs and colleges/schools and reflect an evaluation of the applicant's potential to engage in graduate work and the capability of the individual programs to accommodate additional students. Most programs consider applications as they arrive, while others accumulate applications and make recommendations on admission at certain times during the year. Generally, requests for admission are considered by departmental admissions committees which forward the departmental recommendations to the Dean of the Graduate School.

Students are admitted to full or provisional status in a specific degree program. Admission is granted for a specific semester or summer term. Any change in the admission date must be requested in writing and approved by the department and Graduate School. Once the requirements for that degree program have been completed, no further registration as a graduate student will be permitted unless admission to a new graduate classification has been formally approved. Students

with special objectives may request admission in the "Graduate-Unclassified Status" or register in the "Post-Baccalaureate Studies" program through the Division of Lifelong Education.

ADMISSION TO DEGREE PROGRAMS

Full Graduate Standing

To be considered for admission in full graduate standing, an applicant must have a baccalaureate degree from a college or university recognized as standard by a regional or general accrediting agency and must have at least a "B" average in the undergraduate major or in the latest graduate degree program.

Provisional Admission

1. Provisional admission may be granted to applicants with bachelor's degrees from accredited institutions who lack undergraduate work considered essential for graduate study in a major field. Course work, without graduate credit, will be required to make up such deficiencies before admission to full status can be granted.

Applicants with bachelor's degrees from nonaccredited institutions may be granted provisional admission when their academic records warrant this status. Additional course work will be required of such students when deficiencies in previous training are apparent.

Full graduate standing is granted when the deficiencies responsible for the provisional status are corrected, provided the student has maintained a satisfactory academic record (3.0 Grade Point Average) on all course work taken in a graduate classification. A change from provisional status to full graduate standing is effected only upon the recommendation of the department in which the student is seeking the degree.

2. Students with bachelor's degrees from accredited institutions whose scholastic records are below the standards for admission to full graduate standing may be admitted provisionally when unavoidable, extenuating circumstances affected their undergraduate averages or when progressive improvement in their undergraduate work warrants provisional admission. Students admitted provisionally under these circumstances will have their status changed to full graduate standing after completion of nine or more graduate credit hours following admission provided the student has maintained a GPA of at least 3.0.

A graduate student is not eligible for appointment to an assistantship or fellowship while on provisional status.

MEDICAL HISTORY AND IMMUNIZATION RECORDS

All graduate students admitted to a degree program are required by State law to submit a Report of Medical History and Immunization documentation prior to completing their initial registration. NC State students returning to Graduate School must have their medical history on file updated at the Student Health Center. The required reports should be received in the Student Health Services at least thirty days before registration. If this requirement is not met, a student must be removed from classes.

GRADUATE-UNCLASSIFIED STATUS

The Graduate-Unclassified status is a temporary classification and students admitted to this status are not candidates for degrees. They may take courses for graduate credit but may not apply more than 10 credits earned while in this status to any program leading to an advanced degree at this institution. Unclassified graduate students are expected to meet the same admissions requirements that apply to graduate students in full standing. Any individual having an interest in applying for admission as a Graduate-Unclassified Student should correspond with the Graduate Dean describing his or her particular interests and objectives prior to making application.

Special Graduate-Unclassified Status for International Student Visitors

1. International student visitors must state their educational objectives at NC State and the time expected to accomplish those objectives. The educational objective may not be to seek a graduate degree at NC State.
2. They are expected to meet the same minimum academic admission requirements that apply to graduate students in full standing.
3. They are expected to meet the same TOEFL requirements that apply to international students who are admitted to master's and doctoral programs if they plan to take courses. If they plan to register for Master's Supervised Research 693 or Doctoral Supervised Research 893 only, they are not required to take the TOEFL.
4. They must be recommended by the Director of Graduate Programs in the department in which they plan to take courses or do research.
5. They may be in this special admission status for a period not to exceed one year.
6. They may hold a research assistantship but may not hold a teaching assistantship.
7. They will not be eligible for the Graduate Student Support Plan.

POST-BACCALAUREATE STUDIES (PBS)

The Post-Baccalaureate Studies (PBS) classification is designed for U. S. citizens who wish to undertake academic work beyond the baccalaureate degree but who are not currently admitted to a degree program. This classification is not open to international students with the exception of the spouse of a regularly enrolled NC State student. In special cases where students are sponsored by an agency of the U. S. government for specialized, non-degree study, approval may be given by the Graduate School for registration in the Post-Baccalaureate Studies classification. The following policies apply to students who wish to register for PBS:

1. All must have baccalaureate degrees from accredited institutions of higher education. Registration is through the Division of Lifelong Education.
2. All classes taken for credit by PBS students will be graded in the usual manner that applies for the particular course (A+ through F or S,U). All courses taken at NC State will show on the student's transcript.
3. If the student is admitted as a graduate student, a maximum of nine hours may apply toward the minimum requirements of the degree for which the student is enrolled, including hours approved for graduate credit while classified as a senior, unclassified undergraduate or professional engineering student. The first nine hours of course work taken at the graduate level in the PBS category will be accepted toward degree

- requirements unless a request for some other combination of nine hours is made by the student's advisory committee and approved by the Graduate Dean.
4. Ten hours of PBS credit is allowed when one course is a 4-hour course.
 5. The grade point average (GPA) of a graduate student who has credits in the PBS category will be based on all courses taken at the 400-800 level. However, no course taken six (6) years prior to enrollment into a program can be used to meet the requirements for a later master's degree at NC State.
 6. Registration is limited to a maximum of two courses per semester. Individuals who are employed full-time should limit their PBS registrations to one course per semester.
 7. The PBS classification carries with it no implication that the student will be admitted to the Graduate School in any degree classification.
 8. All course work accepted for degree credit must be approved by the student's advisory committee as being germane to the program. Requests for degree credit for courses completed in the PBS classification are considered after admission to a graduate degree program when the student's Plan of Graduate Work is filed with the Graduate School.
 9. PBS students are expected to familiarize themselves with Graduate School policies and to seek further advice or clarification as needed.

EVENING DEGREE PROGRAMS

Students unable to attend day classes may complete all courses required for a graduate degree in certain areas by enrolling in late afternoon and evening classes. Some of the areas available include: adult and community college education, agricultural education, extension education, counselor education, curriculum and instruction, English, history, liberal studies, management, public administration, public history and technical communication. Contact the department of interest for further information.

COLLEGE OF ENGINEERING PROFESSIONAL DEGREE PROGRAM

Professional degree students are admitted as undergraduate students, are classified as "PR" students and are subject to rules and regulations as established and administered by the Dean of the College of Engineering.

A professional degree student who is subsequently admitted to the Graduate School may, with the approval of the master's advisory committee, the major department and the Graduate School receive graduate credit for a maximum of nine hours credit for courses in which a grade of "B" or higher was received.

COOPERATING RALEIGH COLLEGES

The Cooperating Raleigh Colleges (CRC) is a voluntary organization comprised of North Carolina State University, Meredith College, Peace College, St. Augustine's College, St. Mary's College and Shaw University. Graduate programs are currently offered only at NC State and Meredith College, but the organization provides the opportunity for graduate students to enroll at either institution for a course or courses not offered on their home campus.

Any NC State graduate degree student who is enrolled in at least three graduate credit hours on the NC State campus may take a course at Meredith College during the fall or spring semester,

provided that (a) the course is not taught on the NC State campus and (b) the advisory committee considers the course educationally desirable.

NC State students may not register for more than a total of two courses in any semester at Meredith, and no more than six of the required academic credits for a master's degree at NC State may be accepted from that institution. Grades from Meredith are not used in computing a student's NC State grade point average.

Under this agreement, regular tuition and fees are paid to NC State. Certain special fees may be required for specific courses at Meredith, and the student is responsible for paying these fees.

CERTIFICATE RENEWAL

Public school personnel who are primarily interested in "certification credit" may enroll in the PBS program through Adult Credit Programs and Summer Sessions without forwarding transcripts of previous work to the Graduate School. In such cases, the College of Education and Psychology will be responsible for assessing the adequacy of the applicant's qualifications for enrollment in the course(s) concerned.

Registration and Records

The Office of Registration and Records must have authorization from the Dean of the Graduate School before a graduate student in any classification will be permitted to register for classes. This authorization will be sent to the Office of Registration and Records at the time the student is notified of acceptance for graduate study. All students attending classes must be registered for credit or audit. Grade records are furnished the students at the end of each scheduled school term.

INTERINSTITUTIONAL REGISTRATION

NC State participates in an Interinstitutional Registration program with the University of North Carolina at Chapel Hill, the University of North Carolina at Greensboro and Duke University. Under this agreement, graduate students enrolled at NC State may undertake course work on these campuses upon the recommendation of their advisory committees. Courses offered by North Carolina A&T University and by the University of North Carolina at Charlotte over the Microelectronics Center of North Carolina communications system are also available through Interinstitutional Registration.

Even though taking a course on another campus, the graduate student is exclusively under the administrative direction of the NC State Graduate School. Enrollment for courses on other campuses will take place on this campus, using special forms obtained from the Department of Registration and Records. The Graduate School shall consider courses taken on other campuses as a part of the student's normal load, and the billing for such work will be through the NC State University Cashier's Office. During the summer the procedure is somewhat different in that a student must be enrolled in at least one course on the NC State campus during the same session as the requested interinstitutional registration.

When the grading system on the campus being visited is different from the NC State system, grades received under Interinstitutional Registration will be converted to the NC State system.

"H," "P," "L" and "F" grades earned at the University of North Carolina at Chapel Hill and "E," "G," "S" and "F" grades earned at Duke University will be converted to "A," "B," "C" and "F" grades, respectively.

COURSE LOAD

A full-time graduate course load is 9 to 15 credits per semester (including audits) and 3-6 credits per summer session (including audits). Audits in subjects in which the student has no previous experience will be evaluated at full credit value in determining course load. Audits taken as repetition of work previously accomplished are considered at one half of their value in calculating course loads. With the single exception of foreign language audits, all audit registrations must fall within the range of maximum permissible course loads.

Foreign students on F-1 and J-1 visas are required by the Immigration and Naturalization Service to carry a full-time course of study to remain in status.

Graduate students holding assistantship appointments are restricted to 9 hours per semester if they hold an appointment of one-half-time or greater and 12 hours per semester if they hold a one-quarter-time appointment. With advance written permission from the Graduate School, a student may take more than the maximum semester course load during a particular semester if the total credit hours do not exceed 24 hours per year if the appointment is one-half-time or 30 hours per year for a one-quarter-time appointment.

FULL-TIME STATUS FOR GRADUATE STUDENTS

NC State uses a uniform Schedule of Full-Time Status of Graduate Students for Loan Deferment, Financial Aid, Payroll Tax Withholding and Veteran's Benefits Purposes. To maintain consistency throughout the university system, faculty members do not have the authority to submit individual letters verifying the status of a graduate student. This schedule will be the only resource used to determine a student's status for one of these purposes.

Registration and Records in Room 1000, Harris Hall processes all student loan deferments. The Graduate School will not be directly involved in preparing loan deferment letters.

It is important to reiterate that the full time/ part time requirements set forth in these paragraphs are only used for purposes of determining a student's eligibility for loan deferments, financial aid, payroll tax withholding for graduate assistantships and veterans benefits. These in no way insure membership eligibility in the Graduate Student Support Plan.

Full-time determination for Fall and Spring Semesters

Classification	Full-Time	Half-Time
Master's	<ul style="list-style-type: none"> • Registration for nine (9) or more credit hours per Fall or Spring semester or • A minimum of three (3) hours per semester during the semester in which the student is completing the last course(s) required to complete the degree, or • Three (3) hours per semester of XXX 699 (Master's Thesis Preparation) for students in thesis programs, who have completed all other requirements for their degree, including research credits, except for completing and defending the thesis. 	<ul style="list-style-type: none"> • Registration for 3 - 8 credit hours per Fall or Spring semester. • Registration for one (1) hour of XXX 699 (Master's Thesis Preparation) for students in thesis programs who have completed all other requirements for their degree, including research credits, except for completing and defending the thesis.
Doctorate	<ul style="list-style-type: none"> • Registration for nine (9) or more credit hours per Fall or Spring semester until the student completes all credit hour requirements for the degree, including research credits, and the oral preliminary examination, or • Three (3) hours per semester of XXX 899 (Doctoral Dissertation Preparation) for students who have completed all requirements for their degree (including research credits and the oral preliminary examination) except for completing and defending the dissertation. 	<ul style="list-style-type: none"> • Registration for 3 - 8 credit hours per Fall or Spring semester. • Registration for one (1) hour of XXX 899 (Doctoral Dissertation Preparation) for students who have completed all requirements for their degree (including research credits and the oral preliminary examination) except for completing and defending the dissertation.

Full-time/part-time determination for Summer School Sessions

Graduate students registered for 3 hours or more, or GR 697, in summer sessions are full-time during that session regardless of the length of the session. Students registered for 1-2 hours or any other GR course are half-time for the duration of the summer session, regardless of the length of the session. Students who hold graduate assistantships in the Spring semester and who hold a research assistantship through the following summer months are considered full-time by the University through August 15 as long as they hold the appointment. *In spite of being classified by the University as a "full-time" student during summer semesters solely on the basis of their research or teaching assistantship, a graduate student will not be treated as exempt from F.I.C.A. payroll tax withholding during the summer terms solely on this basis. Only graduate students who are registered for a period of 5 weeks or more during the summer are exempt in this regard.*

Regardless of the semester, student loan deferments are processed by Registration and Records, Room 1000, Harris Hall. The Graduate School is not directly involved with loan deferment letters. Full time/ part time requirements set forth here are only used for determining eligibility for loan deferments, financial aid, payroll tax withholding for assistantships and veterans benefits. These do not insure a membership eligibility in the Graduate Student Support Plan.

Drop Dates for Minicourses

The drop date for a five-week minicourse is the last day of the third week of the minicourse. The drop date for a seven-week minicourse is the last day of the fourth week of the minicourse.

GRADING AND ACADEMIC STADING

The Grading System

NC State University uses the following grading system:

Grade	Grade Points/Credit- Hour
A+	4.33
A	4.00
A-	3.67
B+	3.33
B	3.00
B-	2.67
C+	2.33
C	2.00
C-	1.67
D+	1.33
D	1.00
D-	0.67
F	0.00

Also, S or U grades are given for certain courses. There are no grade points associated with S/U graded courses.

Grading of Graduate Courses

Graduate courses numbered at the 500- and 700-levels are graded A+... F, while 600- and 800-level courses are S/U graded. Typically, lecture courses are at the 500 or 700 level, while *research, seminar and individual study* types of courses are 600- or 800-level courses. Courses regularly graded A+...F and taken for S/U grading cannot be used to satisfy the minimum requirements for the degree.

In order to receive graduate degree credit, a grade of C- or higher is required. To graduate, a student must have a minimum 3.0 average on all graduate course work as well as all courses on the Plan of Graduate Work, including those credits earned in a PBS classification that become a part of the Plan of Graduate Work. This policy is strictly enforced. While S/U graded courses do not affect the grade point average, a student who receives a U on any course will not receive credit for that course and may be required to repeat it.

All grades on courses taken for graduate credit as an undergraduate at NC State and all grades on courses taken in a graduate classification at NC State in courses numbered 400 and above are

included in the graduate grade point average. Courses at the 300 level and below are not eligible for graduate credit and subsequently do not affect the graduate GPA.

Incompletes

At the discretion of the instructor, students may be given an "IN" (Incomplete) grade for work not completed because of a serious interruption in their work not caused by their own negligence. An "IN" must not be used, however, as a substitute for an "F" when the student's performance in the course is not passing. An "IN" is only appropriate when the student's record in the course is such that the successful completion of particular assignments, projects, or tests missed as a result of a documented serious event would enable that student to pass the course. Only work missed may be averaged into the grades already recorded for that student. A student who received an "IN" must complete the unfinished work to have the Incomplete converted to a final grade by the end of the next semester in which the student is enrolled provided that this period is not longer than 12 months from the end of the semester or summer session in which the Incomplete was received; otherwise, the "IN" will be automatically converted to "F" or "U," in accord with the grading approved for the particular course. All grades of "IN" must be cleared prior to graduation. Students must not register again for any courses in which they have "IN" grades; such registration does not remove "IN" grades, and the completion of the course on the second occasion will automatically result in an "F" for the incomplete course.

Except in the case of Interinstitutional Registration, grades on courses transferred from another institution will not be included in computing the grade point average.

Grade Changes

When submitted to the Department of Registration and Records, end-of-course grades are final and not subject to change by reason of a revision of the instructor's judgment nor are submitted grades to be revised on the basis of a second trial (*e.g.*, a new examination or additional work undertaken or completed). Changes may only be made within one calendar year after the date final grades were submitted in order to correct an error of computation or transcribing or where part of the student's work has been unintentionally overlooked.

Academic Warning, Probation and Termination

Graduate students are given a notice of academic warning if they have accumulated less than nine hours at the 400 level or above and have less than a 3.0 GPA. Graduate students are placed on academic probation if they accumulate nine or more but less than eighteen credit hours at the 400 level or above and have a grade point average of less than 3.0 GPA. A student's graduate study is terminated if eighteen or more credit hours at the 400 level or above are accumulated with a grade point average of less than 3.0 GPA. In the case of program termination, no further registration in a graduate classification will be permitted. Under extenuating circumstances the student will be reinstated upon the written recommendation of the department and approval by the Graduate Dean. Departments have the prerogative of recommending the termination of a student's graduate admission at any time if the student is not making satisfactory progress toward the degree.

Students who are eligible to attend the first summer session are eligible to attend either or both summer sessions. For example, students who receive a notice of "Graduate Admission

"Terminated" at the end of the first summer session may register for second summer session unless the major department recommends otherwise.

Eligibility for Assistantship, Fellowship or Traineeship

A graduate student must be in good academic standing (3.0 GPA or better average) to be eligible for appointment to an assistantship, fellowship or traineeship and must be registered in each semester in which the appointment is in effect.

CONTINUOUS REGISTRATION

After a student is admitted to the Graduate School and enrolls for the first time, she/he is required to maintain continuous registration, *i.e.*, be enrolled each semester, excluding summer sessions, until she/he has either graduated or her/his graduate program at NC State has been terminated. All students who graduate during the second summer session must be registered for either the first or second summer session. A student in good academic standing who must interrupt her/his graduate program for good reasons may request a leave of absence from graduate study for a definite period of time, normally not to exceed one year. The request should be made at least one month prior to the term involved. Upon endorsement of the request by the student's graduate advisory committee and Director of Graduate Programs, and approval by the Graduate School, the student would not be required to be registered during the leave of absence. The time that the student spends on an approved leave of absence will be included in the time allowed to complete the degree, *i.e.*, 6 years for master's and 10 for doctoral. Graduate students whose programs have been terminated because of failure to maintain continuous registration and who have not been granted a leave of absence during a fall or spring semester will be required to reapply for admission if they wish to resume their graduate studies at NC State.

SENIORS

A member of the senior class may, with prior approval of the Dean of the Graduate School, register for graduate credit in courses at the 400 through 600 levels as long as the combined graduate and undergraduate credit load is not more than 15 hours. Seniors with an accumulated grade point average of 3.2 or better in their major may enroll for a combined graduate and undergraduate credit load of 18 hours upon the recommendation of the student's advisor and approval by the department and the Graduate School. A senior may accumulate no more than six hours of graduate credit, and those graduate credits may not be applied toward the requirements for a baccalaureate degree. Courses at the 700 and 800 levels are not ordinarily open to undergraduates except for seniors in bachelor's/master's programs, although occasional exceptions are made for senior honor students. Seniors desiring to take courses for graduate credit should contact their major advisers who will forward appropriate requests to the Graduate Dean for approval.

AUDITS

Students wishing to audit courses must have the approval of their advisers and of the instructors teaching the courses. While auditors receive no course credit, they are expected to attend class regularly. The degree to which auditors must participate in class beyond regular attendance is optional with the instructors; any such requirements should be clearly explained to the auditors in writing at the beginning of the semester. An instructor who feels that an auditor has failed to fulfill

the stipulated requirements is justified in marking "NR" (no recognition given for audit) on the grade report roll.

GRADUATION

There are three official graduations for graduate students per year, occurring at the end of the fall and spring semesters and at the end of the second summer session. Formal commencement exercises are held at the end of spring and fall semesters, but any student who graduated the preceding second summer session is eligible to participate in the December commencement. Any doctoral candidate wishing to have the degree conferred in absentia must notify the Graduate School in writing; master's candidates should contact their departments or programs.

Diploma Order Request Cards

The diploma order request card is the form used to order a diploma for a student anticipating graduation at the end of a particular semester or second summer session. The cards are normally due to the Graduate School Office by the end of the third week of classes during the fall and spring semesters and by the graduation deadline noted in the Calendar for the second summer session graduation. Students graduating in the spring are awarded their diplomas during the commencement exercises. In the fall those doctoral graduates attending the commencement exercises receive their diplomas, while the diplomas for those doctoral graduates not attending the exercises and the master's graduates are mailed by the Department of Registration and Records. The diplomas for those students graduating at the end of second summer session and those not attending a formal commencement exercise are mailed by Registration and Records which is also responsible for the ordering of diplomas.

Diplomas

Students earning a Master of Arts, Master of Science, Doctor of Education or Doctor of Philosophy degree will receive diplomas designating the degree but not the program of study. Students earning master's degrees in a designated field will receive diplomas indicating the field of specialization, *i.e.*, Master of Forestry. Students with co-majors will have those identified on their transcripts but not on their diplomas.

Tuition and Fees

Tuition and fees for the 2000-01 academic year and for Summer 2001 are shown below. They are subject to change each year.

A statement of tuition and fees is mailed to each preregistered student approximately five weeks before the beginning of any term. The statement must be returned with full payment or complete financial assistance information by the due date appearing on the statement. Normally the due date is approximately two weeks before classes begin. Non-preregistered students are required to pay their tuition and fees before registering.

SEMESTER RATE SCHEDULE--2000-01 ACADEMIC YEAR
(ALL RATES ARE SUBJECT TO CHANGE WITHOUT NOTICE)

RESIDENTS OF NORTH CAROLINA*		NON-RESIDENTS**
<i>Hours</i>	<i>Tuition and Fees</i>	<i>Tuition and Fees</i>
0-Thesis	\$406	\$1,553
0-2	406	1,553
3-5	653	2,944
6-8	1,059	4,497
9	1,465.50	6,048.50

SUMMER SESSION RATE SCHEDULE--2001

RESIDENTS OF NORTH CAROLINA*		NON-RESIDENTS**
<i>Hours</i>	<i>Tuition and Fees</i>	<i>Tuition and Fees</i>
0-Thesis	\$97	\$374
1	130	499
2	260	998
3	390	11,497
4	520	1,996
5	650	2,495
6	780	2,994
7	910	3,493
8	1,040	3,992
9	1,170	4,491

(*For definition of resident and non-resident students for tuition purposes, see Residence Status for Tuition Purposes.)

Audits: During semester when registered and paying for other course work: One audit free, each additional audit same cost as for credit;

During semester when not registered for other course work: Same cost as for credit;

During any summer session: Same cost as for credit.

Full-time Faculty or Staff: \$ 7

Microfilming Doctoral Dissertation: \$57

FULL-TIME FACULTY AND EMPLOYEES

Full-time faculty of instructor rank and above and other full-time employees of the University who hold membership in the Teachers' and State Employees' Retirement System may register for credit or as auditors with free tuition privileges for one course in any academic term at any campus of the University of North Carolina. Free tuition privileges do not apply during the summer. Each applicant for free tuition must submit through regular channels a form provided by the University.

REFUND POLICY

Refunds for official withdrawals from NC State are prorated, based upon the percentage of the enrollment period attended. No refunds are made for official withdrawals after 50% of the enrollment period. The prorated withdrawal schedule will be publicized through university media after it is established.

COOPERATIVE EDUCATION PROGRAM

The Cooperative Education Program (co-op) is designed to enhance the quality of instruction and learning by providing interested, qualified graduate students a broader understanding of their fields of study and their applicability to the world of work. Over 500 partners in industry, business and government request graduate students for their co-op positions primarily on a full-time basis. Job offers are made by the employer based on student qualifications. Employer needs are a reflection of the labor market. Work assignments are supervised by the employer and monitored by the co-op program staff. On average, 75 graduate students are at work each semester and earn an average of over \$17 per hour. Co-op participants must enroll each term of employment at a cost of \$338.

For admission to the program, students must meet the following criteria:

- Full-time enrollment at NC State immediately prior to the first work session.
- Presentation of an NC State transcript when applying for the program.
- A minimum grade point average of 3.0.
- Attendance at a co-op orientation session.
- Written approval of the graduate advisor or Director of Graduate Programs.
- An interview with the Cooperative Education Director or Coordinator.

International students must also meet visa regulations pertaining to curricular practical training. Further information is provided at orientation sessions. Call 515-4427 for a schedule.

RESIDENCE STATUS FOR TUITION PURPOSES

The basis for determining the appropriate tuition charge rests upon whether a student is a resident or a nonresident for tuition purposes. Each student must make a statement as to the length of his or her residence in North Carolina with assessment by the institution of that statement to be conditioned by the following:

*Residence--*To qualify as a resident for tuition purposes, a person must become a legal resident and remain a legal resident for at least twelve months immediately prior to classification. Thus, there is a distinction between legal residence and residence for tuition purposes. Furthermore, twelve months' legal residence means more than simple abode in North Carolina. In particular, it means maintaining a domicile (permanent home of indefinite duration) as opposed to "maintaining a mere temporary residence or abode incident to enrollment in an institution of higher education." The burden of establishing facts which justify classification of a student as a resident entitled to in-state tuition rates is on the applicant for each classification, who must show his or her entitlement by the preponderance (the greater part) of the residency information.

Initiative--Being classified a resident for tuition purposes is contingent on the student's seeking such status and providing all information that the institution may require in making the determination.

Parents' Domicile--If an individual, irrespective of age, has living parent(s) or court-appointed guardian of the person, the domicile of such parent(s) or guardian is, *prima facie*, the domicile of the individual; but this *prima facie* evidence of the individual's domicile may or may not be sustained by other information. Further, nondomiciliary status of parents is not deemed *prima facie* evidence of the applicant child's status if the applicant has lived (though not necessarily legally resided) in North Carolina for the five years preceding enrollment or re-registration.

Effect of Marriage--Marriage alone does not prevent a person from becoming or continuing to be a resident for tuition purposes, nor does marriage in any circumstance insure that a person will become or continue to be a resident for tuition purposes--poses. Marriage and the legal residence of one's spouse are, however, relevant information in determining residential intent. Furthermore, if both a husband and his wife are legal residents of North Carolina and if one of them has been a legal resident longer than the other, then the longer duration may be claimed by either spouse in meeting the twelve-month requirement for in-state tuition status.

Military Personnel--A North Carolinian who serves outside the State in the armed forces does not lose North Carolina domicile simply by reason of such service. Students from the military may prove retention or establishment of residence by reference, as in other cases, to residential acts accompanied by residential intent.

In addition, a separate North Carolina statute affords tuition rate benefits to certain military personnel and their dependents even though not qualifying for the in-state tuition rate by reason of twelve months' legal residence in North Carolina. Members of the armed services, while stationed in and concurrently living in North Carolina, may be charged a tuition rate lower than the out-of-state tuition rate to the extent that the total of entitlements for applicable tuition costs available from the federal government, plus certain amounts based under a statutory formula upon the in-state tuition rate, is a sum less than the out-of-state tuition rate for the pertinent enrollment. A dependent relative of a service member stationed in North Carolina is eligible to be charged the in-state tuition rate while the dependent relative is living in North Carolina with the service member and if the dependent relative has met any requirement of the Selective Service System applicable to the dependent relative. These tuition benefits may be enjoyed only if the applicable requirements for admission have been met; these benefits alone do not provide the basis for receiving those derivative benefits under the provisions of the residence classification statute reviewed elsewhere in this summary.

Grace Period--If a person (1) has been a bona fide legal resident, (2) has consequently been classified a resident for tuition purposes and (3) has subsequently lost North Carolina legal residence while enrolled at a public institution of higher education, that person may continue to enjoy the in-state tuition rate for a grace period of twelve months measured from the date on which North Carolina legal residence was lost. If the twelve months end during an academic term for which the person is enrolled at a State institution of higher education, the grace period extends, in addition, to the end of that term. The fact of marriage to one who continues domiciled outside North Carolina does not by itself cause loss of legal residence, marking the beginning of the grace period.

Minors--Minors (persons under 18 years of age) usually have the domicile of their parents, but certain special cases are recognized by the residence classification statute in determining residence for tuition purposes.

- (a) If a minor's parents live apart, the minor's domicile is deemed to be North Carolina for the time period(s) that either parent, as a North Carolina legal resident, may claim and does claim the minor as a tax dependent, even if other law or judicial act assigns the minor's domicile outside North Carolina. A minor thus deemed to be a legal resident will not, upon achieving majority before enrolling at an institution of higher education, lose North Carolina legal residence if that person (1) upon becoming an adult "acts, to the extent that the person's degree of actual emancipation permits, in a manner consistent with bona fide legal residence in North Carolina" and (2) "begins enrollment at an institution of higher education not later than the fall academic term next following completion of education prerequisite to admission at such institution."
- (b) If a minor has lived for five or more consecutive years with relatives (other than parents) who are domiciled in North Carolina and if the relatives have functioned during this time as if they were personal guardians, the minor will be deemed a resident for tuition purposes for an enrolled term commencing immediately after at least five years in which these circumstances have existed. If under this consideration a minor is deemed to be a resident for tuition purposes immediately prior to his or her eighteenth birthday, that person on achieving majority will be deemed a legal resident of North Carolina of at least twelve months' duration. This provision acts to confer in-state tuition status even in the face of other provisions of law to the contrary; however, a person deemed a resident of twelve months' duration pursuant to this provision continues to be a legal resident of the State only so long as he or she does not abandon North Carolina domicile.

Lost but Regained Domicile--If a student ceases enrollment at or graduates from an institution of higher education while classified a resident for tuition purposes and then both abandons and reacquires North Carolina domicile within a 12-month period, that person, if he or she continues to maintain the reacquired domicile into re-enrollment at an institution of higher education, may re-enroll at the in-state tuition rate without having to meet the usual 12-month durational requirement. However, any one person may receive the benefit of this provision only once.

Change of Status--A student admitted to initial enrollment in an institution (or permitted to re-enroll following an absence from the institutional program which involved a formal withdrawal from enrollment) must be classified by the admitting institution either as a resident or as a non-resident for tuition purposes prior to actual enrollment. A residence status classification once assigned (and finalized pursuant to any appeal properly taken) may be changed thereafter (with corresponding change in billing rates) only at intervals corresponding with the established primary divisions of the academic year.

Transfer Students--When a student transfers from one North Carolina public institution of higher education to another, he or she is treated as a new student by the institution to which he or she is transferring and must be assigned an initial residence status classification for tuition purposes.

Prevailing North Carolina Law--General Statute (G.S.) 116-143.1 is the prevailing statute governing residence status classification. A copy of the applicable law and/or implementing regulations is available for inspection in the Office of Graduate Admissions, 106 Peele Hall.

Residence-and-Tuition Status applications are also available in the same office and questions should be directed to that office.

Financial Support for Graduate Students

Fellowships and Graduate Assistantships

Graduate students may receive financial support through fellowships, traineeships and teaching or research assistantships sponsored by federal, state and private agencies. Prospective students may request consideration for financial assistance by completing the appropriate sections of the admissions application form. Applicants for these awards should correspond directly with the department of major interest concerning the availability of awards and related information. Enrolled students should contact the major department. Prospective and enrolled graduate students are encouraged to apply for national and regional fellowships in addition to awards sponsored through the University. Information on how to apply for this type of financial assistance is available in the Graduate School or on the "Financing Graduate Education" page on the World Wide Web at <http://www2.acs.ncsu.edu/grad/funding/fellows.htm>. Enrolled or prospective students may also consult the Office of Financial Aid for information on federal loan programs.

A graduate student must be in good academic standing (3.0 GPA or better average) to be eligible for appointment to an assistantship, fellowship or traineeship and must be registered in each semester in which the appointment is in effect. There are also minimum registration requirements for eligibility for tuition and health insurance benefits.

TEACHING, RESEARCH AND SERVICES ASSISTANTSHIPS

The University offers approximately 2,100 assistantships each year. Stipend rates for teaching and research assistantships are competitive with other universities. For further information on the availability of assistantships, applicants should contact the program area of interest. Graduate Teaching Assistants and Graduate Research Assistants may be eligible for health insurance and tuition benefits. Graduate Services Assistants do not participate in these benefits.

DEPARTMENTAL FELLOWSHIPS

Some departments or programs offer fellowships. Students are nominated for these fellowships by their departments or programs with selection being made by faculty committees or by the Graduate School. For additional information concerning such fellowships, the applicant should contact the appropriate college, department or program.

NATIONAL AND REGIONAL FELLOWSHIPS

These awards are made to an individual rather than to the University. Recipients are chosen through competitions expressive of the terms of each award. Examples of these awards held by currently enrolled graduate students follow:

National Science Foundation (NSF) Graduate Research Fellowship
Department of Defense National Defense Science and Engineering Graduate

Fellowship (DOD NDSEG)
Department of Energy Computational Science Graduate Fellowship
EPA Science to Achieve Results (STAR) Fellowships
National Consortium for Graduate Degrees for Minorities in Engineering Inc.
(GEM) Fellowship
National Physical Science Consortium: Graduate Fellowships for Minorities and
Women in the Physical Sciences

Applications and/or information on the above fellowship programs are available in the Graduate School or on the "Financing Graduate Education" page on the web.

GRADUATE SCHOOL FELLOWSHIPS

The **Diversity Graduate Assistance Grant** is a grantsmanship program created by NC State to aid in the support of graduate students from underrepresented groups in all graduate programs of the University. This program provides stipends on a financial need basis up to \$4,000 for the academic year. Recipients must be full-time, new or continuing students pursuing master's or doctoral degrees at NC State. Additional information and application materials are available on the World Wide Web at <http://www.fis.ncsu.edu/grad/grants.htm>

Alumni Association Graduate Fellowship Supplements are funded by the NC State Alumni Association each year in an effort to recruit outstanding graduate students, with the highly competitive award process being coordinated through the Graduate School office. For the 2000-01 academic year twenty-six Graduate Fellowship Supplements were funded; twenty-four of these were awarded across campus, and two were awarded to support the management of University Archives. These supplements are awarded on a one-time-only basis as a financial incentive *and beyond* whatever primary fellowship or assistantship may be offered. In addition, two Alumni Association Graduate International Fellowships are awarded through the International Student Office.

Graduate Assistance in Areas of National Need: The U.S. Department of Education provides support to expedite completion of the doctoral degree for graduate students committed to a career of teaching and research in an identified area of national need. In addition to an annual stipend of up to \$18,000 depending on financial need, the program reimburses educational expenses. To date, NC State has been awarded 104 fellowships for graduate students in the area of electronic materials with 44 fellowships in biotechnology and 43 in scientific computation. Information is available in the Graduate School.

Incentive Scholarship and Grant Program for Native Americans (ISGPNA): The General Assembly of North Carolina has provided funds for doctoral fellowships under the ISGPNA Program for a number of grants to American Indian students interested in pursuing doctoral degrees at NC State. The fellowships have a maximum value of \$4,900 annually.

To be eligible for a fellowship, interested students must be enrolled full-time and in good standing in a doctoral degree program, meet state residency requirements, have financial need and be an American Indian under the program's definition. This definition states that an eligible individual is one who maintains cultural identification as an American Indian through membership in an Indian

tribe recognized by the State of North Carolina or by the federal government or through other tribal affiliation or community recognition.

The Jerry J. Collier Scholarship provides support to an NC State alumnus(a) who participated in a varsity sport during his/her undergraduate tenure and who is entering a graduate program at NC State. The criteria for selection include academic credentials and statement of goals and objectives. The scholarship is \$4,400 for the academic year and is renewable. Information is available in the Graduate School.

Minority Presence Grant Program: Under the Board of Governors' general Minority Presence Grant Program, African-American students may be eligible for special financial assistance if they are residents of North Carolina, enrolled full time and demonstrate financial need.

The Minority Presence Grant Program for Doctoral Study, Law and Veterinary Medicine provides stipends of up to \$4,000 for the academic year, with an option of \$500 in additional support for study in the summer sessions, for African-American residents of North Carolina who are selected to participate. Recipients must be full-time students pursuing doctoral degrees or degrees in veterinary medicine. Additional information and application materials are available on the World Wide Web at www.fis.ncsu.edu/grad/grants.htm.

Integrative Graduate Training in Bioinformatics and Functional Genomics (IGERT): The National Science Foundation provides support for graduate students seeking a Ph.D. in the genomic sciences: either Functional Genomics or Bioinformatics. Key elements of the program are integration of fundamental concepts of functional genomics and bioinformatics through new courses, seminars and a highly interactive journal club. Students select from over 100 genomic sciences faculty for their research training and have the opportunity to gain additional practical experience in the Genome Research Laboratory and the Bioinformatics Research Center. The program provides an \$18,000 annual stipend, tuition, health insurance and university fees (a benefit of \$13,000 for students who are not North Carolina residents in their first year of the programs).

Biotechnology Training Program: The National Institutes of Health and NC State provide support for graduate students in various Ph.D. programs with a research focus in biotechnology. The goal of this program is to enhance the students' research and training in biotechnology beyond the exposure provided by their doctoral programs. The traineeship, typically completed over a two-year period within the Ph.D. program, includes courses in ethical conduct of research, professional development and biotechnology design, an industrial rotation of at least one month, a service project and attendance at monthly seminars and a one-day research symposium. In addition to an annual stipend of at least \$18,000, the program reimburses educational expenses. For more information, please visit: http://www.fis.ncsu.edu/grad_fellows/BTP/facts.html

BENEFITS ASSOCIATED WITH CERTAIN GRADUATE TEACHING ASSISTANTSHIP, RESEARCH ASSISTANTSHIP AND FELLOWSHIP APPOINTMENTS

For a table summarizing benefits and requirements see the Graduate Student Support Plan section of the Graduate School Web site.

Full Payment of In-State Tuition

Full Payment of In-State Tuition: Called an in-state tuition award, this benefit is provided to all eligible students for the following periods:

For Master's Students: 4 semesters from their initial enrollment in the Graduate School at NC State.

For Doctoral Students:

- * With a Master's Degree in the same or related field upon initial enrollment in Graduate School at NC State; 6 semesters from their initial enrollment in the Graduate School at NC State.
- * Without a Master's Degree in the same or related field upon initial enrollment in Graduate School at NC State -- 10 semesters from their initial enrollment in the Graduate School at NC State. The 10 semesters may include up to 4 semesters in a master's classification at NC State as long as they are the first 4 semesters of graduate study at NC State.

Notes:

- * The University is committed to providing this benefit to all eligible students for the time periods specified. Colleges and/or departments may extend this benefit for longer periods of time.
- * This benefit applies only to tuition, not fees. All students must pay required fees unless the source of the stipend provides funds specifically earmarked to pay the recipient's fees.
- * This benefit is available for the Spring and Fall semesters only. Summer sessions are not covered.
- * If the ending date of the qualifying assignment is prior to the end of the semester, then the in-state tuition award amount will be prorated according to the amount of time the student is employed.
- * If the beginning date of the qualifying assignment is after census date for a given semester, the student will not be eligible for the in-state tuition award for that semester.
- * If the effective date of the qualifying assistantship or fellowship appointment is more than 2 weeks after the first day of classes but on or before census day, the tuition award will be prorated.
- * If the qualifying assistantship or fellowship appointment does not run for at least 30 days beyond the first day of class, no tuition benefits will be provided.

Full Payment of Out-of-State Tuition

Tuition remission is a benefit available under the same terms and conditions as the in-state tuition award, detailed above. Students who qualify to establish North Carolina residency will be encouraged to do so by their departments.

Notes:

- The University is committed to providing this benefit to all eligible students for the time periods specified. Colleges and/or departments may extend this benefit for longer periods of time.
- This benefit applies only to tuition, not fees. All students must pay required fees unless the source of the stipend provides funds specifically earmarked to pay the recipient's fees.
- This benefit is available for the Spring and Fall semesters only. Summer sessions are not covered.
- If the ending date of the qualifying assignment is prior to the end of the semester, then the tuition remission amount will be prorated according to the amount of time the student is employed.
- If the beginning date of the qualifying assignment is after census date for a given semester, the student will not be eligible for tuition remission for that semester.
- If the effective date of the qualifying assistantship or fellowship appointment is more than 2 weeks after the first day of classes but on or before census day, the tuition award will be prorated.
- If the qualifying assistantship or fellowship appointment does not run for at least 30 days beyond the first day of class, no tuition benefits will be provided.

Health Insurance

The NC State Graduate Student Health Insurance plan covers all eligible students under the following terms and conditions:

- The annual coverage period is August 16-August 15. An eligible student with a nine-month Teaching Assistantship appointment (August 16-May 15) that is in force on May 15 will continue to receive coverage through the end of the coverage period.
- There is no limitation on the number of semesters one may receive coverage.
- Eligible-student coverage is at no cost to the student.
- Spouse coverage is available for purchase by the student.
- Child coverage is available for purchase by the student.
- A student who loses/terminates his/her appointment mid-year has the option of purchasing the same insurance for an additional 18 months through COBRA.
- In addition, a student who loses/terminates his or her appointment but remains a student at the university may choose to purchase health insurance through the NC State Student Preferred Care Medical Plan for the remainder of the year.

The coverage provided is identical to that found in the NC State Student Preferred Care Medical Plan, with the following notable exceptions: The \$1 million catastrophic coverage that is optional in the student plan is included in the Graduate Student Support Plan.

For information on insurance premium rates see the Graduate Student Support Plan section of the Graduate School Web site.

For a brochure describing the Graduate Student Health Insurance plan see the Graduate Student Support Plan section of the Graduate School Web site.

Requirements

Eligibility Requirements

Minimum Stipend Level

For in-state tuition awards, tuition remission, and health insurance

To be eligible, students must be appointed on a teaching assistantship, research assistantship, or fellowship paid through the University receiving a minimum **annualized** stipend of \$3,000 per semester or \$8,000 per year (\$666.67 per month).

Note: Supplemental fellowships do not contribute to the \$3,000 (or \$8,000) total. Graduate Services Assistantships are not eligible for the Graduate Student Support Plan. A definition of graduate teaching assistants, graduate research assistants and graduate services assistants can be found in the Graduate Administrative Handbook.

Assistantship and Fellowship Appointment Deadlines

For in-state tuition awards and tuition remission

To receive the in-state tuition award and out-of-state tuition remission, students **must be** appointed to their assistantships or fellowships and approved through Division level by the census date (the 10th day of classes) of that semester.

However, to ensure tuition payments are made in a timely manner, appointments to assistantships or fellowships should be made by the following deadlines:

- Fall Semester: August 16
- Spring Semester: January 1

For health insurance

The effective date for health insurance will be based on the effective date of the appointment.

Enrollment Requirements for Eligible Students

Minimum Stipend Level

For in-state tuition awards, tuition remission and health insurance

To be eligible, students must be appointed to a teaching assistantship, research assistantship or fellowship paid through the university receiving a minimum **annualized** stipend of \$3,000 per semester or \$8,000 per year (\$666.67 per month).

ENROLLMENT

For in-state tuition awards and tuition remission

Master's Students - Must register for a minimum of 9 credits each semester for the first 3 semesters that they receive tuition benefits and a minimum of 3 credit hours in the fourth semester.

Doctoral Students with a master's degree in the same or related field upon initial admission to the Graduate School - Must register for a minimum of 9 credits for each semester for the 6 semesters that they receive tuition benefits.

Doctoral Students without a master's degree in the same or related field upon initial admission to the Graduate School - Must register for a minimum of 9 credits for each semester for the first 8 semesters that they receive tuition benefits and a minimum of 3 credit hours in the 9th and 10th semester.

For health insurance

The enrollment requirements for health insurance are the same as those for tuition during the semesters mentioned above. Required enrollment for semesters beyond those in which the student is eligible for tuition is 3 credit hours.

Other Financial Aid

LONG-TERM LOANS

Graduate students who are American citizens or eligible non-citizens may apply for long-term, low interest loans through the Office of Financial Aid. To qualify for loans, students must be making satisfactory academic progress towards a degree and must complete the appropriate application materials to demonstrate that all federal eligibility requirements for loan consideration have been met. The *Free Application for Federal Student Aid* (FAFSA) is the form required to document eligibility for federal loan assistance. In addition, students must complete the university's *Institutional Application*. Although students are expected to apply for and to accept any available assistantships or fellowships provided by the Graduate School, it is recommended that students not wait for these decisions to be made before applying for financial aid through the Office of Financial Aid. If graduate assistantships or fellowships are offered, and borrowing no longer becomes necessary, students have the option to cancel their requests for loan assistance at any point.

Federal Stafford Loans (Subsidized and Unsubsidized): Funding for these loans is provided by private lenders. Since they are partially supported by the federal government, however, students must follow federal guidelines in applying for aid to qualify. Information on specific application procedures, loan maximums, interest rates and participating lenders may be obtained from the Office of Financial Aid. Students who apply for these loans and demonstrate need by federal definition qualify for Federal Subsidized Stafford Loans, meaning that the federal government pays the interest on the loan while the student is enrolled on at least a half-time basis. If no need is demonstrated, students may still borrow to meet the cost of education (minus other resources, such as scholarships, fellowships and tuition remissions) through the Federal Unsubsidized Stafford Loan Program. Students who receive unsubsidized loans are charged interest while enrolled,

although they may elect to capitalize interest payments to repay with principal upon completion of degree. For both subsidized and unsubsidized loans, repayment of principal is deferred until completion of the degree or until termination of at least half-time enrollment status.

Other Loan Options: Because of limited institutional funds, graduate students generally are expected to apply for the maximum Federal Subsidized and Unsubsidized Stafford Loans for which they are eligible if funding is needed to assist with educational expenses. Students who need to borrow more than the maximum amounts possible through those loan programs (the combined annual maximum is \$18,500) will be considered for other loan funds administered by the Office of Financial Aid if sufficient funding is available.

WORK-STUDY JOBS

The Federal Work-Study Program is a federal program designed to provide part-time jobs to students who apply for financial aid using the Free Application for Federal Student Aid and who document need by federal guidelines. Effort is made to assign students to jobs with their special interests and skills. Most of the jobs are on-campus, but limited opportunities for off-campus employment in community service areas are also available.

PART-TIME JOBS

Other jobs not based on need are posted under Student Employment on NC State's homepage and are displayed on a bulletin board outside of the Office of Financial Aid. These jobs are open to all students.

SHORT-TERM EMERGENCY LOANS

Loans, usually in amounts of \$100 or less, to meet emergency expenses may be obtained on short notice (generally on the day of application) at the Financial Aid Office. These loans, in that they are designed for short-term, emergency use, must be repaid within about 30 days. A loan may not be taken out between semesters or between summer sessions.

Military Education and Training

The Reserve Officer Training Corps (ROTC) selects interested university students for enrollment in Army ROTC (AROTC), Navy (NROTC) or Air Force ROTC (AFROTC) for officer education and training leading toward a commission in the respective military service.

Air Force ROTC: Air Force Reserve Officers Training Corps (AFROTC) is one of the three commissioning programs in the United States Air Force. Graduate students who will be at NC State for at least two years may, upon successful completion of a five-week summer leadership training period, be enrolled in the ROTC Program. In some cases, graduate students with only three semesters remaining may enroll in AFROTC. The AFROTC curriculum stresses four main areas: leadership and management, professional knowledge, defense studies, and communication skills where students will learn valuable skills which can be applied to schoolwork and apply to a job upon graduation. AFROTC offers scholarships to many of its qualified students. Most of these scholarships cover the cost of tuition, and all scholarships entitle the cadet to an allotment for books and a monthly stipend. AFROTC provides an active, exciting college program that could

lead to a promising career in the US Air Force. Generally speaking, students completing the program serve four years as a commissioned officer and will gain unique experiences and knowledge valuable not only in the military but also in the civilian world as well. If a student is interested in learning to fly, the AFROTC program is a possible way to get started. Students with three or more semesters of remaining course work may be eligible to enroll in Air Force ROTC. Uniforms and books for ROTC are provided. Additional information may be obtained by calling the Department of Aerospace Studies at 515-2417 or from http://www.ncsu.edu/airforce_rotc.

Army ROTC: Army ROTC is an educational program combining college electives in military science with practical leadership training to prepare men and women to become U. S. Army officers. Traditionally, Army ROTC is a four-year program with the first two years of the program comprising the Basic Course. There is also a special program for juniors and graduate students who did not take Army ROTC during their first two years of college. To enter the two-year program, a student must first participate in a five-week basic leadership instruction course then after successfully completing this course, students may qualify to join ROTC as an Advanced Course Cadet. The Advanced Course will impart valuable experience in leadership development, military history, time management, and military customs and courtesies.

ROTC training goes beyond the typical college classroom in that students will not only learn skills one would expect to find in an Army officer including how to motivate co-workers, cope with the unexpected and organize large, complex tasks, but they will also learn skills such as teamwork, tact, and effective communication which are in demand in both the civilian and business world.

Army ROTC awards scholarships to many qualified students based strictly on merit to the most outstanding students who apply, regardless of their family financial status. Army ROTC Advanced Course students also receive a tax-free stipend of \$200 per month. Scholarship students receive tuition, the \$200 stipend and \$450 per school year for books. Students entering the Advanced Course must agree to complete a period of military service, either Active Duty, Army Reserve or Army National Guard upon graduation. Students successfully completing the ROTC course will graduate with a diploma and a commission as a Second Lieutenant in the U.S. Army. A Professor of Military Science can provide a more detailed explanation of military service obligations and can also answer any other questions which may arise about Army ROTC. Call (919) 515-2428, visit the web site at http://www2.ncsu.edu/ncsu/army_rotc or visit the offices next to the Student Center in Reynolds Coliseum for more information.

Navy ROTC: Naval Reserve Officers Training Corps (NROTC) Program was established to educate and train qualified young men and women for service as a commissioned officer in the Navy or Marine Corps. The largest single source of Navy and Marine Corps officers, the NROTC program fills a vital need in preparing mature young men and women for leadership and management positions in an increasingly technical Navy and Marine Corps. Upon graduation from NC State, members receive a commission in the Navy or Marine Corps, where they can pursue careers as Naval Aviators, Surface Ship Warriors, Submariners or Marines. The diversity that the NROTC program offers demonstrates the diversity that has made the Navy-Marine Corps team so successful. The NROTC Program offers both a two- and three-year scholarship which covers the cost of tuition and entitles the midshipman to an allotment for books and a monthly stipend. A midshipman will be required to complete 21 hours of Naval Science courses, many of which can be used as electives in his/her current program. The two-year scholarship recipients must attend five weeks of training the summer after joining the program in order to obtain half of these credits. Naval ROTC is a great opportunity to learn the skills needed to lead and manage people in the

technical Navy and Marine Corps of today. For more information please call the Naval Science Department at 515-6833.

Health Services

Student Health Services, located in the Student Health Center, offer health care to students in a facility staffed by six full-time physicians, six Nurse Practitioners, pharmacists, registered nurses, physical therapists, health educators and support staff. A travel clinic and allergy clinic are also offered.

During fall and spring semester, Health Services is open 8:00 a.m. to 9:00 p.m. Monday-Friday and 8:00 a.m.-12:00 noon weekends (except during holidays and breaks). Appointments are needed to see a health care provider and may be made in person at the Health Center or by calling 515-7107. Gynecology appointments are made at 515-7762. Urgent medical problems will be seen at the clinic without appointment. Physicians maintain office hours Monday through Friday, 8:00 a.m.-5:00 p.m. During summer sessions, hours are Monday-Friday, 8:00 a.m.-5:00 p.m.

All currently enrolled students are eligible for medical care. The pre-paid health fee covers professional services such as nurse and M.D. visits, laboratory tests, cold medications and health education. There is a reduced charge for x-rays, prescriptions and specialty clinics. Students are responsible for all services received off-campus, e.g., off-campus M.D., hospital or lab/x-ray.

HEALTH INSURANCE

NC State strongly encourages each student to have accident and sickness insurance protection, either by their parents' group policy or under the NC State Student Insurance Plan. The policy offered by the University helps cover the cost of referrals to off-campus specialists or to hospitals for serious illnesses. For your protection, do not be uninsured! International students are required to have the NC State Student Insurance Plan. A brochure describing the NC State student plan is mailed to all students in July. Call (919) 828-0240 for additional information.

Housing

OFF-CAMPUS HOUSING

The Housing Assignments Office maintains listings of off-campus housing accommodations provided by private landlords and students seeking roommates; however, arrangements for off-campus housing must be made by students seeking accommodations. The listings change frequently, and most landlords and tenants prefer to complete the rental transaction in person rather than by telephone or mail. The Housing Assignments Office, 1112 Pullen Hall, is open from 7:30 a.m. until 5:00 p.m., Monday through Friday.

EDWARD S. KING VILLAGE

The University also maintains 295 apartments in E. S. King Village for students with families, for single parents and graduate students. Rental rates are far below market value. Specific rates for studio, one- and two-bedroom apartments) can be obtained by calling (919) 515-2430. The E. S. King fax number is (919) 515-7613.

ON-CAMPUS HOUSING

The University furnishes housing for approximately 7,000 students. The residence halls are grouped in three areas: East, Central and West Campus. Each of the areas provides laundry facilities, convenience stores, computer labs, grassy areas for sports and more.

The 2001-02 rental fee for a basic residence hall double room is \$1,260 per student per semester (the premium hall rate is \$1,610 per student per semester), subject to change on an annual basis. For more information about amenities and/or availability, call the Housing Assignments Office at (919) 515-2440 The University Housing fax number is (919) 831-3542. The University Housing home page resides at <http://www2.ncsu.edu/ncsu/housing> on the Internet.

GRADUATE PROGRAMS

The Graduate School offers programs of study leading to the master's degree in 91 fields and the doctorate in 54. Each student's program is planned with an advisory committee of graduate faculty members to provide the opportunity for gaining advanced knowledge in the particular field of study. Graduate education is the final stage in the development of intellectual independence. It is different from undergraduate education in that the student is encouraged to establish premises, to hypothesize and to defend both the procedure and the conclusions of independent investigation. The burden of proof for the verifiability of knowledge rests on the student, not on the faculty member. Emphasis is placed upon the student's scholarly development through formal course work, seminars, research and independent investigation.

Graduate students are expected to familiarize themselves with the requirements for the degrees for which they are candidates and are held responsible for the fulfillment of these requirements.

Master's Degrees

The Graduate School offers programs of study leading to the Master of Science degree, the Master of Arts degree and the Master's degree in certain designated fields.

MASTER OF SCIENCE AND MASTER OF ARTS

For all Master of Science and Master of Arts degrees, the programs are planned with the objective of making possible a reasonable, comprehensive mastery of the subject matter in a chosen field. In most cases, the Master of Science and Master of Arts programs provide training and experience in research in order to familiarize the student with the methods, ideals and goals of independent investigation. In these cases, representative of most Master of Science and Master of Arts degree programs, a thesis is required. A small number of Master of Science and Master of Arts programs do not require a thesis.

MASTER'S DEGREE IN A DESIGNATED FIELD

A number of departments and programs offer master's degrees in designated fields. These are professional degrees and do not require a thesis.

REQUIREMENTS FOR MASTER'S DEGREES

All departments and programs offering non-thesis master's degrees may choose to offer the degree as an "Option B" program which has a different set of requirements from regular master's programs. These programs will be identified in the section of this catalog titled "Fields of Instruction." Differences between the requirements of regular programs vs. Option B programs, where appropriate, are identified below.

GRADUATE ADVISOR AND GRADUATE ADVISORY COMMITTEE

All students in master's programs must have a graduate advisor who is a member of the Graduate Faculty in the student's major department or program. The graduate advisor is appointed by the Director of Graduate Programs. In addition, all students, except those in Option B programs, must

have a graduate advisory committee. The advisory committee is composed of at least three members of the Graduate Faculty. The graduate advisor serves as chair or co-chair of the committee. If the student has a minor, then one of the committee members must be from the minor department or program. The graduate advisory committee is appointed by the Director of Graduate Programs in the student's department or program. At the time of the request for a permit to schedule the final oral examination, the Graduate School verifies that the committee is constituted properly.

PLAN OF GRADUATE WORK

The student's program of study is planned so as to provide a comprehensive view of the major field of interest and in related areas of knowledge, sometime constituting a minor. As great a latitude is permitted in the selection of courses as is compatible with the well-defined major and, in many cases, supporting courses or a minor. In general, it is expected that at least two-thirds of the credits will be in the major. If there are credits in a minor or supporting areas, they normally would not exceed one-third of the total. Since there are many possible combinations of course work, a specific Plan of Graduate Work is developed by the advisory committee with the student. The course work to be taken by the student and the thesis topic, where applicable, must be approved by the student's advisory committee and the Director of Graduate Programs in the student's department or program. This should be done prior to completion of one-half of the credits on the plan.

CREDITS

A minimum of 30 semester credit hours is required for all master's degrees; however, many programs require more than thirty. Also, many students, in order to gain the breadth desired in their program or to make up deficits in their undergraduate degree, will actually take more credit hours than the minimum required by the program. At least 20 semester hours must come from 500-800-level courses. No more than two credit hours of departmental seminar may be included in the minimum 30-credit program. Programs that require a thesis may include no more than six hours of research credit (695) in the minimum 30-credit-hour program. Research credit is not appropriate in the non-thesis programs. Non-thesis programs may include no more than six hours of independent study credits in the minimum 30-credit program. Courses at the 400 level counted toward the minimal 30-hour requirement may not come from the major field. Master's thesis preparation (699) credits may not be used to satisfy the 30-credit hour requirement.

Transfer credit: No more than six of the minimal 30-hour requirement will be accepted from other institutions. A graduate course which has been completed with a grade of "B" or better may be considered for transfer to a master's program provided that it has been completed in a graduate or post-baccalaureate classification at an accredited graduate school. Exceptions are allowed for transfer from foreign institutions if the department or program provides the Graduate School with adequate documentation that the course is relevant to the degree with appropriate content and level of instruction resulting in student competencies at least comparable to those of students taking the equivalent course at NC State and that the course was taught by faculty who are qualified to teach at the master's degree level. Transfer credit may not be used to fill the 20-hour 500-800-level requirement. Credit accepted by extension reduces the amount of credit that may be transferred from other institutions.

Transfer of Undergraduate Credit: Graduate credit may be allowed for up to 6 hours of the minimal 30-hour requirement for courses taken at NC State provided that it is at the 400 level or higher, that the grade is "B" or better, that it was not counted to fulfill undergraduate requirements, and that it is recommended by the student's undergraduate advisor prior to enrollment in the course. No graduate credit will be allowed for excess credits completed in an undergraduate classification at another institution.

Credit by Extension: A maximum of six semester credits taken prior to admission to a graduate program and earned through NC State extension study may be applied toward the minimal 30-hour requirement provided that the courses are graduate-level and taught by members of the NC State Graduate Faculty. If a student has been admitted to the Graduate School, six additional semester credits earned through NC State extension study may be used to meet the minimal 30-hour requirement. No graduate credit will be allowed for courses completed by extension at universities other than NC State. Credit accepted by extension reduces the amount of credit that may be transferred from other institutions.

Credit by Examination: Credit by examination in graduate courses may be awarded for up to six credit hours. Passage of the examination entitles the student to credit only for the course; letter grades are not allowed for credit by examination. Credit by examination may not be obtained for research, seminars, project courses or audits. Residency requirements are not fulfilled by courses in which credit is awarded by examination. Credit by examination is permitted when all of the following conditions exist: a course required on the Plan of Graduate Work is not taught within time periods indicated by the Graduate Catalog or in time periods limited by agreements with outside agencies; the student requesting the examination has not previously registered for the course, either for credit or audit; the academic standards for credit by examination are commensurate with the academic standards for the course; the examination for credit is approved by the Director of Graduate Programs and the examination is prepared by and supervised by appropriate faculty; credit is to be given only when the performance is judged to be equivalent to a "B" grade or higher; only one examination for credit is to be permitted for the same course; the request for credit by examination is approved by the Graduate School.

Credits from Previous NC State Master's Degree: Only six credits from a previous NC State master's degree may be counted toward the minimal 30-hour requirement.

Second Master's in the Same Field: The Graduate School will not admit or transfer a student to a master's program if he/she holds a master's degree in the same discipline without a statement of justification by the student's Director of Graduate Programs.

MINOR

The Graduate School does not require a minor; however, individual departments and programs may require a minor. All students, except those in Option B programs, have the option of selecting a minor. In most cases, the minor will be in a single department or program. In some cases, an interdisciplinary minor, consisting of related credits from more than one department or program, will be selected. When a student does select a minor, the minor credits on the Plan of Graduate Work must be approved by the graduate advisory committee member, and, in some cases, the Director of Graduate Programs, from the minor department or program.

CO-MAJOR

Students may co-major at the master's level with the approval of both departments and/or programs and appropriate representation on the advisory committee. Co-majors must be within the same degree area, *i.e.*, Master of Science and Master of Science, Master of Arts and Master of Arts, Master's degree in a designated field and Master's degree in a designated field. Co-majors must meet all requirements of both departments and/or programs. On degree is awarded, and the co-major is noted on the transcript. Enrolled co-majors will be classified in one program for record purposes.

LANGUAGE REQUIREMENTS

A reading knowledge of one foreign language (Germanic, Romance or Slavic) is required by some programs for the Master of Arts and the Master of Science degrees. Other departments may designate that the language requirement be filled from among those languages in which the Department of Foreign Languages and Literatures conducts testing. Students should contact the major department for specific language requirements.

Proficiency can be demonstrated in one of two ways:

1. By passing a traditional reading knowledge examination, which can be requested by the student at any time from the Department of Foreign Languages and Literatures.
2. By passing the final examination in a course especially designed for graduate students who have no previous knowledge of a foreign language or who wish to refresh their knowledge of a language. The Department of Foreign Languages and Literatures offers such courses, normally in the fall, for each of the three major foreign languages: French (FLF 401), German (FLG 401) and Spanish (FLS 401). These courses concentrate exclusively on teaching students to understand the written word and do not provide instruction or testing in speaking and original composition. Failure to pass the course carries with it no penalty other than the fact that the student's language requirement will remain unfulfilled. These courses are neither counted for credit nor used in computing the grade point average.

THESIS

Theses prepared by candidates for the Master of Science and Master of Arts degrees, in programs requiring the thesis, must present an original investigation into a subject which has been approved by the student's advisory committee and the Director of Graduate Programs in the student's major. Three copies of the thesis in final form as approved by the advisory committee, each signed by the members of the advisory committee, must be submitted to the Graduate School by a specific deadline in the semester or summer session in which the degree is to be conferred. As an alternative, students may submit their theses in electronic format. Detailed information on the form and organization of the thesis is presented in the Graduate School's *Thesis and Dissertation Guide* which is available at the NC State Bookstores.

COMPREHENSIVE WRITTEN EXAMINATIONS

Written examinations covering the subject matter of the major and supporting fields and/or the minor may be required. When required, such examinations must be successfully completed prior to requesting a permit to schedule the comprehensive final oral examination. Information concerning written examination schedules should be obtained from the student's department or program.

COMPREHENSIVE FINAL ORAL EXAMINATIONS

Candidates for master's degrees, except those in Option B programs, must pass a comprehensive oral examination to demonstrate to the advisory committee that he/she possesses a reasonable mastery of the subject matter of the major and supporting fields and that this knowledge can be used with promptness and accuracy. This examination may not be held until all other requirements, except completion of the course work in current registration during the final semester, are satisfied. A request for a permit to schedule the examination may be filed with the Dean of the Graduate School after the above conditions are met. The Graduate School will check to determine that the advisory committee and the courses taken by the student meet Graduate School requirements. If all requirements are met, the permit to schedule the final examination will be forwarded to the Director of Graduate Programs within 20 days of receipt of the request. Upon receipt of the permit, the student may proceed to schedule the exam at a time that is convenient to all members of the advisory committee. In those programs which require the thesis, the thesis must be submitted in complete form, except for such revisions which may be necessary as a result of the final exam, to all members of the advisory committee at least two weeks prior to the exam.

A unanimous vote of approval of the advisory committee is required for passing the oral examination. Approval of the examination may be conditioned, however, upon completion of additional work to the satisfaction of the advisory committee. A formal reexamination will not be required in this case. Failure of a student to pass the oral examination terminates the student's graduate work at NC State unless the graduate advisory committee unanimously recommends a reexamination. Only one reexamination will be given. A form giving the date that the exam was conducted and the result of the examination and signed by all members of the advisory committee is forwarded to the Dean of the Graduate School by the Director of Graduate Programs in the student's department or program. A student may appeal all committee actions according to the Board of Trustees Policy 41-04, Uniform Student Grievance Procedure, following the NC State University Administrative Regulations on Grievance Procedures for Students.

Oral examinations for master's degree candidates are open to the Graduate Faculty by right and to the University community by unanimous consent of the advisory committee and the student being examined. Discussions and decisions regarding the student's performance are private to the advisory committee.

Students in Option B master's programs are not required to take a final oral examination.

RESIDENCE

Students engaged in a course of study leading to the master's degree are required to be in residence, pursuing graduate work, for a minimum of one full academic year or its equivalent.

TIME LIMIT

All requirements for the master's degree must be completed within six calendar years, beginning with the date that the student first registers for courses carrying graduate credit applicable to the degree program, unless a more restrictive time limit has been established by the student's department or program or his/her college.

Summary of Procedures for Master's Degrees

ALL STUDENTS

- Application materials and required fees received.
- Application materials reviewed by department or programs.
- Department or program forwards recommendation regarding applicant's admissibility to the Graduate Dean.
- The Graduate School reviews the recommendation and the student is notified of the action taken on the request for admission.
- Student arrives, reports to the department or program, is assigned a graduate advisor and develops a roster of courses and credits with the advisor.
- Student complies with requests from Graduate School for updates copies of transcripts from previous colleges or universities.
- Student signs patent agreement and files with Graduate School.
- Student subject to continuous registration policy until graduation.
- Student passes language examination, if required.
- Student passes written examination, if required.
- Student submits diploma order form by end of sixth week of the semester or summer session of anticipated graduation.
- A grade point average of at least 3.00 for the degree requirements as well as on overall graduate course work at NC State is required for graduation.
- All degree requirements must be completed within six calendar years, beginning with the date the student commences courses carrying graduate credit applicable to the degree program, unless a more restrictive time limit has been established by the department/program or academic college/school

STUDENTS IN OPTION B PROGRAMS

- Plan of Graduate Work prepared by the student, in consultation with and with the approval of his/her graduate advisor and approved by Director of Graduate Programs prior to completion of one-half the credits on the plan.
- Director of Graduate Programs submits requests for graduation checkout to the Graduate Dean no later than 30 working days after the first day of the semester (seven working days after the first day of the summer session) in which the student is taking the last course on his/her Plan of Graduate Work and anticipates graduation.

STUDENTS IN NON-THESIS PROGRAMS

- Graduate advisory committee of three or more Graduate Faculty members is appointed by the Director of Graduate Programs.
- Plan of Graduate Work prepared by the student, in consultation with and with the approval of his/her graduate advisory committee and approved by the Director of Graduate Programs prior to completion of one-half the credits on the plan.
- When all requirements except completion of the course work in the final semester are satisfied, Director of Graduate Programs requests that the Graduate School issue permit to schedule the final oral examination.
- If Graduate School requirements are met, a permit to schedule the final examination is issued by the Graduate School within 20 working days of receipt of the request.
- Final examination is scheduled and conducted.
- Final examination report, including date and result of the examination, submitted to the Graduate School by the Director of Graduate Programs. Report should be received by the Graduate School within five working days of the examination.
- The deadline date for unconditionally passing the final examination in order for the student to graduate in a given semester or summer session appears in The Calendar in this catalog as well as other Graduate School calendars.

STUDENTS IN THESIS PROGRAMS

- Graduate advisory committee of three or more Graduate Faculty members is appointed by the Director of Graduate Programs.
- Plan of Graduate Work prepared by the student, in consultation with and with the approval of his/her graduate advisory committee and approved by the Director of Graduate Programs prior to completion of one-half the credits on the plan.
- A copy of a preliminary draft of the thesis, if required, is submitted to the chair of the student's advisory committee.
- When all requirements except completion of the course work in the final semester are satisfied and after the thesis is complete except for such revisions as may be necessary as a result of the exam, the Director of Graduate Programs requests that the Graduate School issue permit to schedule the final oral examination.
- If Graduate School requirements are met, a permit to schedule the final examination is issued by the Graduate School within 20 working days of receipt of the request.
- At least two weeks prior to the final oral examination, the chair of the student's advisory committee submits the thesis, if required, to the other members of the advisory committee for review.
- Final examination is scheduled and conducted.
- Final examination report, including date and result of the examination, submitted to the Graduate School by the Director of Graduate Programs. Report should be received by the Graduate School within five working days of the examination.
- Student submits three copies of the thesis, signed by each member of his/ her advisory committee, to the Graduate School.
- The deadline date for submitting three copies of the thesis to the Graduate School in order for the student to graduate in a given semester or summer session appears in The Calendar in this catalog as well as other Graduate School calendars.

- The thesis is reviewed by the Graduate School to insure that the format conforms with the specifications prescribed in the *Thesis and Dissertation Guide*.

Doctor of Philosophy and Doctor of Education Degrees

The doctorate symbolizes the ability of the recipient to undertake original research and scholarly work at the highest levels without supervision. The degree is therefore not granted simply upon completion of a stated amount of course work but rather upon demonstration by the student of a comprehensive knowledge and high attainment in scholarship in a specialized field of study. The student must demonstrate this ability by writing a dissertation reporting the results of an original investigation and by passing a series of comprehensive examinations in the field of specialization and related areas of knowledge.

Requirements for Doctorate Degrees

ADVISORY COMMITTEE AND PLAN OF GRADUATE WORK

An advisory committee of at least four graduate faculty members, one of whom will be designated as chair, will be appointed by the Dean of the Graduate School upon the recommendation of the director of graduate programs of the major department or program. The committee, which must include at least one representative of the minor field, will, with the student, prepare a Plan of Graduate Work which must be approved by the Director of Graduate Programs of the major department and the Graduate School. In addition to the course work to be undertaken, the subject of the student's dissertation must appear on the plan; and any subsequent changes in committee or subject or in the overall plan must be submitted for approval.

The program of work must be unified, and all constituent parts must contribute to an organized program of study and research. Courses must be selected from groups embracing one principal subject of concentration, the major, and, when appropriate, from a cognate field, the minor. Normally, a student will select the minor work from a single discipline or field which, in the judgment of the advisory committee, provides relevant support to the major.

CO-MAJOR

Students may co-major at the doctoral level with the approval of both departments and the appointment of a co-chair from each department or program on the advisory committee. Co-majors must meet all requirements for majors in both departments. One degree is awarded and the co-major is noted on the transcript. Co-majors are not permitted between Doctor of Philosophy and Doctor of Education degree programs. Enrolled co-majors will be classified in only one program for record purposes.

RESIDENCE REQUIREMENT

For the Doctor of Philosophy and the Doctor of Education degrees, the student is expected to be registered for graduate work at an accredited graduate school for at least six semesters beyond the baccalaureate degree.

The basic University residence requirements are defined below. However, academic colleges/schools have the prerogative of establishing more restrictive requirements within the respective schools. (The College of Education requires a minimum of one academic year of full-time resident study).

At least two residence credits, as defined below, must be secured in continuous residence (registration in consecutive semesters) as a graduate student at the University. Failure to take work during the summer does not break continuity; however, summer work may be used in partial fulfillment of this requirement.

Residence credit is determined by the number of semester hours of graduate work carried during a given term. During a regular semester, residence credit is calculated in the following manner:

Semester Credits (Hours)	Residence Credits
9 or more	1
6-8	2/3
Less than 6 (including registration for "DR Dissertation Preparation" or "Dissertation Research")	1/3

The residence credit for a six-week summer term is equal to one-half of the corresponding amount for a regular semester. For example, six semester hours carried during a summer session will earn one-third of a residence credit; less than six credit hours will earn one-sixth of a residence credit.

CREDITS

A minimum of 54 credit hours beyond the master's degree are required for doctoral degrees; however, some departments or programs may require more than 54. Students who bypass the master's degree or get a master's degree at NC State as part of the doctoral program are required to earn a minimum of 72 credits beyond the bachelor's degree. Again, some departments or programs may require more.

LANGUAGE REQUIREMENTS

A reading knowledge of at least one modern foreign language (Romance, Germanic or Slavic) is required by some departments for the Doctor of Philosophy degree. Other departments may designate that the language requirement be filled from among those languages in which the Department of Foreign Languages and Literatures conducts testing. Doctoral students should contact the major department for specific language requirements. For the Doctor of Education degree, the decision as to whether or not there will be a language requirement is left to the student's advisory committee.

The Department of Foreign Languages and Literatures offers courses in French, German and Spanish especially designed for graduate students who have no previous knowledge of a foreign language or who wish to refresh their knowledge of a language. These courses concentrate exclusively on teaching students to understand the written word and do not provide instruction or

testing in speaking and original composition. A passing grade on the final examination in one of these courses is sufficient evidence of a reading knowledge of the language.

To demonstrate comprehension in depth of one language, a student must not only prove that one possesses a reading knowledge of the language but also that he or she is proficient in the oral and compositional elements of that language. Students desiring to master one language in depth should consult the head of the Department of Foreign Languages and Literatures concerning the specific courses which will be necessary to achieve this comprehension; specific arrangements will depend upon the student's background in the language.

Students whose native language is other than English may use English as one of the languages when two are required for the Doctor of Philosophy degree. When English is submitted in partial fulfillment of the dual language requirement, the native language may not be used as the other language.

When only one language is required in the student's program, certification for that language must occur on this campus.

PRELIMINARY COMPREHENSIVE EXAMINATIONS

After completing the language requirement, if required, but not earlier than the end of the second year of graduate study and not later than one semester (four months) before the final oral examination, each doctoral student is required to take the preliminary comprehensive examinations. The examinations consist of two parts: written examinations and an oral examination. Requirements for written examinations in the minor field, if appropriate, are left to the discretion of the department or program in which the student is minoring.

The written portion may be conducted in one of two ways. In the first, each member of the advisory committee prepares a set of questions for the student's response, and answers to each set are returned to the appropriate member for grading. This procedure is used by departments which have a relatively small number of doctoral students.

Many of the larger departments have developed departmental written examinations to be used for all students, and scheduled dates are announced well in advance. Where written departmental examinations of this kind are used, the student will be expected to make arrangements to schedule these examinations.

Regardless of the method employed, the questions involved may cover any phase of the course work taken by the student during graduate study or any subject logically related to an understanding of the subject matter in the major and minor areas of study. The questions are designed to measure the student's mastery of the subject matter and the adequacy of preparation for research. Failure to pass the written preliminary examinations terminates the student's work at this institution, subject to departmental and/or school policies with respect to reexamination.

Upon satisfactory completion of the written portion of the preliminary examinations and after completion of all course work relevant to the examination, authorization for the preliminary oral examination is requested from the Graduate School. This examination is conducted by the student's advisory committee and is open to all graduate faculty members. The student and the

examining committee will be notified by the Graduate School of the arranged time and place. The oral examination is designed to test the student's ability to relate factual knowledge to specific circumstances, to use this knowledge with accuracy and promptness and to demonstrate a comprehensive understanding of the field of specialization and related areas.

A unanimous vote of approval by the members of the advisory committee is required for the student to pass the preliminary oral examination. Approval may be conditioned, however, on the successful completion of additional work in some particular field(s). All committee actions may be appealed following university policies and regulations on student grievances.

Failure to pass the preliminary oral examination terminates the student's work at this institution unless the examining committee recommends a reexamination. No reexamination may be given until at least one full semester has elapsed, and only one reexamination is permitted.

CANDIDACY

A doctoral student is admitted to candidacy upon passing the preliminary examinations without conditions or after fulfilling any conditions specified by the advisory committee.

FINAL ORAL EXAMINATION

The final oral examination is scheduled after the dissertation is complete except for such revisions as may be necessary as a result of the examination, but not earlier than one semester or its equivalent after admission to candidacy and not before all required course work has been completed or is currently in progress. The examination consists of the candidate's defense of the methodology used and the conclusions reached in the research, as reported in the dissertation. It is conducted by an examining committee, which consists of the student's advisory committee. This examination is open to the University community.

A unanimous vote of approval of the advisory committee is required for passing the final oral examination. Approval may be conditioned, however, on the student's meeting specific requirements prescribed by the student's advisory committee. Failure of a student to pass the examination terminates one's work at this institution unless the advisory committee recommends a reexamination. No reexamination may be given until one full semester has elapsed and only one reexamination is permitted.

THE DISSERTATION

The doctoral dissertation presents the results of the student's original investigation in the field of major interest. It must represent a contribution to knowledge, be adequately supported by data and be written in a manner consistent with the highest standards of scholarship. Publication is expected.

The dissertation will be reviewed by all members of the advisory committee and must receive their approval prior to submission to the Graduate School. Three copies of the document signed by all members of the student's advisory committee must be submitted to the Graduate School by a specific deadline in the semester or summer session in which the degree is to be conferred. As an alternative, students may submit their dissertations in electronic format. Prior to final approval, the

dissertation will be reviewed by the Graduate School to insure that the format conforms to the specifications prescribed in the *Thesis and Dissertation Guide*. Detailed information on form and organization of the dissertation is presented in the University's *Thesis and Dissertation Guide* which is available in the NC State Bookstores.

The University has a requirement that all doctoral dissertations be microfilmed by University Microfilms International, of Ann Arbor, Michigan, which includes publication of the abstract in *Dissertation Abstracts International*. The student is required to pay for the microfilming service. (See "Special Registration and Fees" under "Tuition and Fees.")

TIME LIMIT

Doctoral students are allowed a maximum of six calendar years from admission to the doctoral program to attain candidacy for the degree and a maximum of ten calendar years to complete all degree requirements. Academic colleges/schools or departments may have more restrictive requirements than the above stated policy.

Summary of Procedures for Doctor of Philosophy and Doctor of Education Degrees

- Application materials and required fee received.
- Application materials reviewed by department or program.
- Department or program forwards recommendation regarding applicant's admissibility to Graduate Dean
- Graduate School reviews the recommendation and notifies the student of the action taken on the request for admission.
- Student arrives, reports to the department or program, is assigned a graduate advisor and develops a roster of courses and credits with the advisor.
- Student complies with requests from Graduate School for updated copies of transcripts from previous colleges or universities
- Student signs patent agreement and files with Graduate School
- Student subject to continuous registration policy until graduation.
- Advisory committee of at least four graduate faculty members appointed by the Graduate Dean upon the recommendation of the director of graduate programs.
- Graduate Dean appoints a Graduate School Representative to student's committee, if required.
- A dissertation subject is selected and an outline of the proposed research submitted to the student's advisory committee and the director of graduate programs for review and approval.
- Plan of Graduate Work prepared by the student, in consultation with and with the approval of his/her graduate advisory committee and director of graduate programs, and forwarded to the Graduate School for approval as soon as feasible after completion of 12 hours of course work.
- Student passes language examination(s), if required.
- Written examinations in the major and minor fields, if appropriate, are scheduled no earlier than the end of the second year of graduate study and not later than one semester before the final oral examination.
- When all written examinations have been completed satisfactorily, the director of graduate programs requests the scheduling of the preliminary oral examination at least

two weeks prior to the suggested date. Upon approval of the request, the Graduate School notifies the student and the examining committee of the time and place.

- The report of the examination is sent to the Graduate School and if the examination has been passed without conditions, the student is admitted to candidacy.
- A copy of the preliminary draft of the dissertation is submitted to the chair of the student's advisory committee for review.
- At least two weeks prior to the final oral examination, the chair of the student's advisory committee submits the dissertation to advisory committee members for review. A copy is submitted to the Graduate School Representative at least one week prior to the exam.
- One semester or its equivalent after admission to candidacy or later, after the dissertation is complete except for such revisions as may be necessary as a result of the final examination, and at least two weeks prior to the suggested date, the student's advisory committee chair or director of graduate programs requests the scheduling of the final oral examination. Upon approval of the request, the student and the examining committee, including the Graduate School representative, are notified of the time and place of the examination.
- Results of the final oral examination are forwarded to the Graduate School.
- Upon passing the final oral examination, three copies of the dissertation signed by each member of the student's advisory committee and five copies of the abstract must be submitted to the Graduate School by a specific deadline in the semester or summer session in which the degree is to be conferred. As an alternative students may submit their dissertations in electronic format. One copy each of the University Microfilms Agreement, the Survey of Earned Doctorate, and the Graduate School Exit Survey forms must be completed and submitted with the dissertation.
- The dissertation is reviewed by the Graduate School to insure that the format conforms with the specifications prescribed in the *Thesis and Dissertation Guide*.
- All course work scheduled in a graduate degree classification must be completed prior to graduation.
- A grade point average of at least 3.0 for the degree requirements as well as on overall graduate course work at NC State is required for graduation.
- The doctoral residence requirement of 2 residence credits must be satisfied.
- All degree requirements must be completed within ten years from admission to the doctoral program.

The NC State Libraries

Graduate students are one of the NC State Libraries' most active user groups, and the library is committed to supporting their needs for information resources and services. The library system consists of the main D. H. Hill Library; four branches serving the specialized needs of programs in design, natural resources, textiles and veterinary medicine; and an affiliated library serving the College of Education and Psychology. Three studies in the D. H. Hill Library are available only to graduate students for use of computers or as lounges. The D. H. Hill Library is open 24 hours a day during the fall and spring semesters.

The Libraries' collections contain more than 2.8 million volumes of books and bound journals, nearly 36,000 serials, and hundreds of electronic resources. They are particularly strong in the biological and physical sciences, engineering, agriculture, forestry, textiles and architecture, with the arts, humanities and social sciences also well represented. The NC State Libraries is a U.S. government documents depository and a U.S. patent depository. The Media Center offers audio, video and multimedia materials, with equipment for group and individual use. A Scanning Lab provides help with converting materials to digital formats.

The NC State Libraries Information System extends access to a growing array of online resources, from indexes to full-text journals, which are accessible from both on and off campus. Users can search the NC State Libraries' holdings as well as those of Duke, UNC-Chapel Hill and NC Central. In the Libraries' Learning and Research Center for the Digital Age, the Learning Technologies Service offers help in applying new information technologies to instruction (e.g., in developing web-based courses), the Information Technologies Teaching Center offers instruction in their use and the Scholarly Communication Center gives guidance in matters such as copyright. Laptop computers are available for in-building use in D. H. Hill and the branches.

The Libraries provides interlibrary loan services to obtain material from other research libraries. Direct borrowing privileges are available with Duke, UNC-Chapel Hill and other UNC system schools. The TRIPSaver service delivers library materials from Duke, UNC-CH or NCCU with 48 hours of request. Also available are orientation tours, lectures on library use for all new students, e-mail reference service and in-depth reference service geared to the individual needs of graduate students. Distance Learning Services are available for students and faculty engaged in on-campus instructional programs.

Institutes

RESEARCH TRIANGLE - The unique "Research Triangle" in North Carolina has captured national and international attention. It is comprised of the Research Triangle Park, a world-renowned research park, and three major research universities. Because of this wealth of educational and research opportunities, the Triangle area contains the highest total of Ph.D. scientists and engineers on a per capita basis in the nation. The Triangle Universities--NC State, the University of North Carolina at Chapel Hill and Duke University--have a subsidiary campus in the Research Triangle Park--the Research Triangle Institute. The Institute, which operates as a contract research organization, has an annual research revenue of approximately \$122 million.

The Research Triangle Park, founded in 1959, now has more than 59 public and private industrial research facilities, situated on 6,800 acres of land. Over 34,000 people work in the park and over 30,000 additional jobs have been created outside the Park as a result of its existence. Organizations in the Park include such government facilities as the National Humanities Center, the National Institute of Environmental Health Sciences, the Environmental Protection Agency, and the National Center for Health Statistics. Private companies such as Glaxo Smith Kline, Nortel and Reichhold Chemicals have their North American headquarters in the Park. Two major, state-supported research initiatives in microelectronics and biotechnology are located in the Park and North Carolina's Supercomputing Center is housed there as well. Faculty and graduate students from the universities work closely with many of the Park companies. Scientists and researchers from companies like GlaxoSmithKline, IBM and Becton-Dickinson frequently hold adjunct appointments in one or another of the Triangle Universities.

INSTITUTE OF STATISTICS - The Institute of Statistics is composed of two sections, one at NC State and the other at UNC-Chapel Hill. At NC State, the Institute provides statistical collaborative services to all branches of the institution, sponsors research in statistical theory and methodology and coordinates the teaching of statistics at the undergraduate and graduate levels. The instructional and other academic functions are performed by the Department of Statistics, which forms a part of the Institute.

WATER RESOURCES RESEARCH INSTITUTE - The Water Resources Research Institute is a unit of the UNC System headquartered in Jordan Hall on the NC State campus. It is one of 54 state water institutes authorized by the Water Resources Research Act of 1964 to administer and promote federal/state partnerships in research and information transfer on water-related issues. WRRI receives federally appropriated funds through the U.S. Department of Interior and state funding through the UNC system to enable it to identify and support research needed to help solve water quality and water resources problems in N.C. Research is conducted by faculty and graduate students of senior colleges and universities in N.C. WRRI publishes peer-reviewed reports on completed research projects and arranges for technology transfer from researchers to state agency personnel and others who can put the research results to work. The Institute also sponsors educational seminars and conferences and provides public information on water issues through publication of a newsletter.

Special Laboratories, Facilities and Centers

BIOLOGY FIELD LABORATORY - The Biology Field Laboratory is located eight miles from the University campus and comprises a 20-acre pond, 180 acres of extremely varied vegetation types and a modern laboratory building. The latter contains two laboratories, one for class use and another principally for research.

The many unique ecological situations found in this area make it ideal for use by advanced classes of most biological science departments. Likewise, the area is well adapted to a variety of research projects by faculty, graduate students and undergraduates because of its habitat diversity. The close proximity of the laboratory facility to the campus makes possible many types of behavioral, physiological, ecological, taxonomic and limnological studies that could be accomplished only with great difficulty at other locations.

CENTER FOR ADVANCED ELECTRONIC MATERIALS PROCESSING (AEMP) - The Center for Advanced Electronic Materials Processing was established in 1988. The center's program is interdisciplinary and involves collaboration among chemists, physicists, materials scientists and electrical, chemical, computer and mechanical engineers. The research focuses on the development of electronic materials processing technologies that will provide the capability of producing submicron electronic devices. The program emphasizes low thermal budget processes using plasma and thermal and optically assisted techniques as well as the automation and control of those processes. It is a joint effort with researchers from the University of North Carolina (Chapel Hill and Charlotte), Duke University, North Carolina A&T State University and MCNC.

CENTER FOR ASEPTIC PROCESSING AND PACKAGING STUDIES (CAPPs) - The Center for Aseptic Processing and Packaging Studies was established in October 1987 to promote cooperative research between university and industrial researchers and to further scientific knowledge in areas of food and pharmaceutical aseptic processing and packaging. The center is funded by the National Science Foundation, NC State and industrial members from food, pharmaceutical and packaging industries. The objectives of the center are to support industrially relevant, fundamental research in aseptic processing and packaging, to enhance product quality and improve efficiency, and to communicate information gained from basic research to industry for development and marketing.

Graduate students working on CAPPs projects will be exposed to industrial concerns and given the opportunity to work first-hand with industry in solving problems and making practical application of their research.

CENTER FOR ADVANCED COMPUTING AND COMMUNICATION - CACC is an NSF-sponsored Industry/University Cooperative Research with research sites at NC State and Duke University. An advisory board comprised of representatives of member companies and government agencies meets twice a year to direct the Center's research activities. Faculty and graduate students also work closely with each member's technical staff on a variety of research projects.

The Center's mission is to carry out basic and applied research on problems having both industrial and academic relevance, to transfer these results to the members and to provide students with a challenging educational opportunity. The research goal is to create concepts, methods and tools for

use in the analysis, design and implementation of advanced computer and communication systems. CACC has the unique capability to develop technology from theory to prototype.

CENTER FOR ENGINEERING APPLICATIONS OF RADIOISOTOPES - The Center for Engineering Applications of Radioisotopes was established in 1980 within the Department of Nuclear Engineering and associated with the Department of Chemical Engineering. It is composed primarily of faculty and their graduate students doing research related to the measurement applications of radiation and radioisotopes in industry. This includes the use of short-lived radioactive tracers, radiation gauges, radiation analyzers and industrial computed tomography. Excellent experimental facilities are available including solid state detectors and the NC State PULSTAR Reactor. The Center's programs are financed largely by an Associates Program of Industrial Members and contracts and grants from industry and federal agencies.

CENTER FOR LEARNING TECHNOLOGIES (CLT) - The Center for Learning Technologies is a multimedia service facility located in the College of Education and Psychology. Students are instructed through workshops, classes and/or individualized training in the effective delivery of information and the design/production of instructional materials using a variety of computer technologies.

CENTER FOR RESEARCH AND DEVELOPMENT IN MATHEMATICS AND SCIENCE EDUCATION - The center, one of ten centers in the North Carolina Mathematics and Science Education Network, is the only research and development center in the network. Established within the Department of Mathematics, Science and Technology Education in 1984, the center conducts research and development activities for precollege students, preservice teachers, in-service teachers and University faculty. The center identifies areas of need in mathematics and science education and forms partnerships with federal, state, local and private funding agencies to work collaboratively to address the increasing student achievement. Grants have been obtained from the National Science Foundation, Office of Education, State Department of Public Instruction, Local Education Agencies and IBM to introduce changes that incorporate technology and active learning into the mathematics and science curriculum, K-16. In addition, the center supports graduate students and provides them with opportunities to write grants and to design, conduct and report on educational research.

CENTER FOR RESEARCH IN SCIENTIFIC COMPUTATION (CRSC) - The Center for Research in Scientific Computation is a formally recognized, multidisciplinary center of the greater University of North Carolina System. The CRSC is administered by NC State and the College of Physical and Mathematical Sciences. The purpose of the Center is to promote research in scientific computing and to provide a focal point for research in computational science, engineering and applied mathematics. Data-massive and/or computationally intensive problems provide ideal projects for training graduate students in applied mathematics. With advanced computing methodologies, students and postdoctoral fellows address important issues in processes of modelling and design.

Research topics of interest to CRSC faculty include a variety of problems in scientific computation, numerical analysis and numerical optimization with applications to such areas as fluid mechanics and flow control, smart materials and structures, nondestructive testing, acoustics, material sciences and manufacturing processes, population dynamics, environmental sciences, signal processing, computer performance evaluation and nuclear reactor physics.

CENTER FOR SOUND AND VIBRATION - The Center for Sound and Vibration, established in 1969 and administered within the Department of Mechanical and Aerospace Engineering, is composed of faculty pursuing the solution of a wide variety of problems such as occur in machinery and aircraft design particularly related to vibration and sound. Graduate programs exist at M.S. and Ph.D. levels in fields such as noise and vibration control, aeroacoustics, hearing conservation, computer-aided machinery design, active control of vibration and sound, and signal processing. Outstanding experimental facilities, including large anechoic and reverberant rooms and computer graphics equipment, are available. The Center's programs are financed largely by grants and contracts from industry and federal and state agencies.

DIAGNOSTIC TEACHING CLINIC - The Diagnostic Teaching Clinic is operated by the graduate program in special education within the College of Education for the purposes of providing graduate students with opportunities to gain both observational and applied clinical experience in diagnosing and teaching exceptional students of all ages. The clinic accepts referrals from local school systems and from agencies and individuals within the community. Staff, which includes graduate interns, evaluates the referred clients, develops educational programs for them in conjunction with the referring agency and demonstrates teaching techniques for the benefit of those persons who will work with the children. This clinic is open during the day, late afternoon and early evening hours during the fall and spring semesters and throughout the summer months and is utilized by graduate students from several departments with allied curricula in education and psychology.

ELECTRIC POWER RESEARCH CENTER - The Electric Power Research Center is a university/industry cooperative research center established in 1985 within the College of Engineering. The Center is funded by the university and sponsoring organizations from the various sectors of the electric utility industry including nuclear fuel vendors. The purpose of the Center is to foster the excellence of research and graduate-level degree programs in electric power systems engineering. Motivation for industrial firms to join with the Center derives from close university/industry interaction, the pooling of membership dues to sponsor research of mutual interest and the enhanced professional and research opportunities provided to faculty and students. The current research program mainly involves faculty from the Department of Nuclear Engineering.

ELECTRON MICROSCOPE FACILITIES - There are three electron microscope facilities at NC State available to graduate students and faculty for research purposes. The College of Agriculture and Life Sciences (CALS) Center for Electron Microscopy is located in Gardner Hall, the College of Engineering (COE) Analytical Instrumentation Facility (AIF) is in Burlington Engineering Labs, Engineering Graduate Research Center (EGRC) is located on Centennial Campus and the College of Veterinary Medicine (CVM) Laboratory for Advanced Electron and Light Optical Methods (LAELOM) is located in the NC State College of Veterinary Medicine on Hillsborough Street.

The CALS Center for Electron Microscopy offers complete service support in all areas of Biological Electron Microscopy. The Center has two scanning microscopes: a Philips 505T and a JEOL T-300 and two transmission electron microscopes: a JEOL 100S and a Philips 400T-STEM equipped with a C400M computer control system. The Center is also equipped with all of the necessary biological preparatory equipment.

Formal instruction is provided through the microbiology curriculum for transmission electron microscopy, scanning electron microscopy and ultramicrotomy. The Center also provides support, service and training in a wide variety of digital imaging. Advanced techniques are provided on an individual basis or through workshops.

The COE Analytical Instrumentation Facility (AIF) is equipped with an Hitachi S-3200N variable pressure scanning transmission microscope (VPSEM), two high resolution JEOL 6400F field emission scanning electron microscopes (FESEM) and a Cameca IMS-6f Ion Microscope. One 6400F is equipped with a Link Pentafet energy dispersive x-ray system capable of detecting low Z elements (down to boron). In addition, all microscopes are equipped with both film and direct digital imaging capabilities. Digital data acquisition capability allows direct computer display and storage of images greatly facilitating image processing and utilization for reports and publications.

The S-3200N VPSEM accommodates large (6-inch diameter) specimens and in the variable pressure mode can image wet, oily and non-conductive specimens in their natural state with up to 35A resolution, greatly reducing or eliminating sample preparation requirements.

The JEOL 6400F field emission SEMs can handle up to 6-inch diameter samples and operate at very low accelerating voltages while maintaining high spatial resolution. The superior brightness and small spot size of the cold cathode field emission electron sources on JEOL 6400F instruments enable them to resolve 14A at an accelerating voltage of 30 keV and 70A at 1.0 keV.

The state-of-the-art Cameca IMS 6f Ion Microscope is a high-performance, secondary ion mass spectrometry (SIMS) equipped with oxygen, cesium and gallium ion sources providing ppb to ppt sensitivity for most elements and a digital data acquisition system for acquiring and processing both 2-D and 3-D elemental distributions with atomic layer depth resolution and <0.1 μ m lateral resolution.

All microscopes are supported by complete materials specimen preparation, dark room and data processing facilities including several light microscopes and x-ray diffractometers. AIF analytical professionals teach regularly scheduled courses as well as short courses covering the analytical techniques available through AIF. They are also available for collaboration with and direct one-on-one instruction for graduate students.

The CVM Laboratory for Advanced Electron and Light Optical Methods (LAELOM) - The CVM LAELOM is a research/service/teaching facility housing all the optical equipment to examine cytological, histological and gross specimens, and the equipment to perform morphometric analyses, and to prepare material for presentations and publication. Individuals can prepare their own cryosections for light microscopy and immunological staining and can also prepare their own transmission and scanning electron microscopy samples. In addition, the LAELOM staff can prepare any and all of these materials for investigators as well as cut ultrathin frozen sections for immunolabeling and enzyme cytochemistry. The LAELOM offers individual training in light microscopy, morphometry and darkroom work as well as a formal course in biological transmission and scanning electron microscopy techniques (CBS 732). A course covering photography and photomicroscopy in scientific illustration is taught in the LAELOM as part of the summer Biotechnology series (BIT 815Q). A computer-operated Philips EM208S transmission electron microscope was installed in May 1999 in complement the JEOL JSM-35 CF

scanning electron microscope. An automated Olympus VANOX photomicroscope and WILD photomicroscope are available to students and investigators as well as a fully equipped darkroom for processing black-and-white negatives and prints. Equipment for making black-and-white 2 x 2 slides for projection is available. The LAELOM offers consultation services for all these techniques in terms of specimen preparation, film selection, and cost determination for purposes of grant preparation. The LAELOM is fully GLP-compliant.

HIGHLANDS BIOLOGICAL STATION - NC State is an institutional member of the Highlands Biological Foundation which provides support for the Highlands Biological Station of the University of North Carolina. This is an inland biological field station located at Highlands, North Carolina. The town of Highlands is in the heart of the Southern Appalachians at an elevation of 3,823 feet. The area has an extremely diverse biota and the highest rainfall in the eastern United States.

Facilities are available throughout the year for pre-and post-doctoral research in botany, zoology, soils and geology. The laboratory building with research rooms and cubicles and the library are well equipped for field-oriented research. Also, five cottages and a dining hall are located on the edge of a six-acre lake. In addition to 16 acres surrounding the lake, the station owns several tracts of undisturbed forested land available for research. Research grants available through the Station provide stipends for room, board and research expenses.

INTEGRATED MANUFACTURING SYSTEMS ENGINEERING INSTITUTE- The Integrated Manufacturing Systems Engineering Institute was established at NC State in 1984 to provide interdisciplinary educational, research and technology transfer program in manufacturing systems engineering. The objectives of this program are to educate engineers in the theory and practice of integrated manufacturing systems technology; to conduct basic and applied research on topics in cooperation with industry on problems of contemporary manufacturing system; and to engage in technology transfer with industry.

Central to all aspects of the Institute's operation and activity is in the integration of computer-aided processes in the design and control of manufacturing facilities. Through both internally and externally funded research projects the Institute contributes to the solution of generic design and manufacturing engineering problems and provides a vehicle for technology transfer.

LEARNING RESOURCES LIBRARY - The Learning Resources Library, administered by the College of Education, is located in Poe Hall. The library maintains a collection of print and audio-visual materials and equipment with emphasis on teaching methods, research, administration and psychology. An extensive collection of state-adopted secondary level textbooks includes French, Spanish, language arts, mathematics, science, social studies and vocational education. Audio-visual equipment is available for instruction, research and previewing.

MARS MISSION RESEARCH CENTER - The Mars Mission Research Center is one of eight University Space Engineering Research Centers established by NASA to broaden the nation's engineering capability to meet the critical needs of the civilian space program. The goal of the center is to focus on educational and research technologies used in the design of spacecraft for planetary exploration with particular emphasis on Mars. It is a cooperative program involving faculty, undergraduate and graduate students at NC State and NC A&T State University. The research is a cross-disciplined program involving (1) hypersonic aerodynamics and propulsion, (2)

composite materials and fabrication, (3) light-weight structures and (4) spacecraft controls. Students and faculty conduct part of their research at NASA Centers and participating industries.

MATERIALS RESEARCH CENTER - The Materials Research Center was established in 1984 at NC State as an interdisciplinary program involving persons representing the Departments of Chemistry, Electrical and Computer Engineering, Materials Science and Engineering and Physics. The present thrust area of the Center concerning thin films and coatings serves as a focal point for this cooperative research. The experimental efforts are conducted within the four departments noted above.

MCNC - NC State is a participating member of MCNC which conducts research programs in information and electronics technologies in partnership with other N. C. institutions. Other participating institutions are UNC-Chapel Hill, Duke University, NC A&T State University, UNC-Charlotte and the Research Triangle Institute.

Faculty and students at NC State have access to the use of MCNC facilities on sponsored research projects. Areas of interest include systems design, systems engineering, integrated circuit fabrication technology, semiconductor materials, device physics, advanced packaging and interconnection technologies, micro-electromechanical systems (MEMS), high performance computing and advanced networking research and development. Departments at NC State which are actively involved in the program include electrical and computer engineering, computer science, physics, chemistry, and materials science and engineering.

NUCLEAR REACTOR PROGRAM - The Nuclear Reactor Program (NRP) provides specialized nuclear facilities to the North Carolina academic and industrial communities. These facilities are used for teaching, research and service. The NRP supports graduate research and undergraduate programs in a wide variety of academic departments. Facilities include the PULSTAR Nuclear Reactor, the Nuclear Services Analytical Laboratories, Health Physics Laboratories and the Scaled Pressurized Water Reactor Facility (SPWRF). The PULSTAR Reactor is a 1-megawatt research and training reactor. Irradiation capabilities include wet and dry vertical ports, horizontal beam tubes, a pneumatic transfer system and a graphite thermal column. Neutron radiography, prompt gamma activation analysis and neutron depth profiling facilities are permanently installed.

The Nuclear Services Laboratories are well-equipped to perform routine reactor irradiations, neutron activation analysis, isotope production and low-level counting. The laboratories maintain ten high-purity Ge and GeLi detectors, two multi-station Nuclear Data Acquisition and Analysis Systems, a Liquid Scintillation Counting System, an Alpha Spectroscopy System, sample preparation equipment and an extensive set of standards. The SPWRF is a non-nuclear working scale model of a two-loop pressurized water reactor that is used for teaching and research.

The Nuclear Reactor Program is part of the Department of Nuclear Engineering and is located in the Burlington Engineering Laboratories on the main NC State campus.

OFFICE OF INFORMATION TECHNOLOGY - The Office of Information Technology provides computing services and networking services via the University's Data Communications

System. This system links most computing systems on campus, including the on-line library catalog, and also provides access to the Internet.

The Information Technology facility includes a UNIX- and NT-based client/server environment and software, including word processing, electronic mail, spreadsheets and math tools. Several networked public facilities are located on campus. Information Technology also provides an array of centralized services including data networking, consultation, short courses, software licensing, campus electronic information system through World Wide Web and instructional support.

A number of specialized computing facilities also exist in most colleges/schools which provide specialized education and research computing for their students. The University participates in the North Carolina Supercomputing Center and provides high bandwidth communications to CRAY vector and parallel supercomputers at the Center.

ORGANIZATION FOR TROPICAL STUDIES - NC State is an institutional member of the Organization for Tropical Studies (OTS), a consortium of North and Central American universities which maintains field research and teaching facilities in Costa Rica. Each year OTS offers a series of courses that are open to NC State graduate students including tropical biology, agroecology, agroforestry and tropical agricultural biology. These 8-week courses, offered in winter and summer, are taught in Costa Rica and make use of a network of OTS field stations located throughout the country.

The OTS facilities in Costa Rica also provide a unique opportunity for tropical research by NC State graduate students and faculty. The principal field station, located in the northeastern Atlantic lowlands, has excellent laboratory and housing facilities and provides access to a 3,500-acre tract owned by OTS. Another station is located at mid-elevation in southeastern Costa Rica near the Panamanian border. OTS also utilizes various other sites, including a seasonally dry area in the northwestern part of the country and a high-elevation area at 10,000 feet in the Talamanca range. More information about OTS may be obtained through the International Programs Office of the College of Agriculture and Life Sciences.

PESTICIDE RESIDUE RESEARCH LABORATORY - The Pesticide Residue Research Laboratory is a facility in the College of Agriculture and Life Sciences devoted to determining the environmental fate of pesticide residues primarily in air, plants, soils and water. Although the laboratory is administered through the Department of Toxicology, it serves the total needs of the College in cooperative research projects requiring pesticide residue analysis.

Although the laboratory functions as a focal point for residue research involving interdepartmental cooperation, the faculty in the laboratory conduct independent research on the fate of pesticides, indoors, after applications in urban environments and their movement and persistence in plants, soils and water after agricultural applications.

The laboratory is equipped with gas, High Performance Liquid and Capillary Electrophoresis chromatographs, a GC/MS and all ancillary items required to prepare samples for quantitation. Graduate study can be undertaken in any aspect of pesticide residue research either in the Pesticide Residue Research Laboratory or through one of the cooperating departments.

PRECISION ENGINEERING CENTER - The Precision Engineering Center was established in 1982. The goal is to develop techniques for metrology and manufacturing at tolerances below those attainable with current technology. For example, fabrication of future electro-optical devices will require manufacturing tolerances better than 1 millionth of an inch. This goal requires new methods for measuring and controlling the parts being produced or the process being performed. Specific research objectives involve the study of metrology systems, control algorithms, machine structural dynamics, optics, materials, and micro-processors and the details of many different fabrication processes. An interdisciplinary team of faculty from Mechanical and Aerospace Engineering, Materials Science and Engineering, Computer Science and Physics along with research staff and graduate students are working together to address these research areas. The Center is housed in a state-of-the-art facility on the Centennial Campus.

PSYCHOEDUCATIONAL CLINIC AND LABORATORIES - The Department of Psychology operates the Psychoeducational Clinic located in Poe Hall. The clinic provides both a service to the public and training for school psychology graduate students. The Clinic serves children from preschool through adolescence, and services include evaluation, intervention and consultation.

SEA GRANT COLLEGE PROGRAM - North Carolina Sea Grant College Program is a state/federal partnership program involving all campuses of the University of North Carolina system. Sea Grant combines the university's expertise in research, extension and education to focus on practical solutions to problems in the area of coastal and marine resource use and conservation. Graduate and undergraduate research opportunities rest with individual project directors on campus via a special graduate fellowship program administered through the program office.

SOUTHEASTERN PLANT ENVIRONMENTAL LABORATORIES -- PHYTOTRON - The Southeastern Plant Environment Laboratory, often referred to as the NC State Phytotron, is especially designed for research dealing with the response of plants and microorganisms to their environment. A high degree of environmental control makes possible simulation of a wide range of climates found in tropical, temperate and northern zones.

Research in the Phytotron deals with all phases of plant biology. Although the majority of the studies are conducted with agricultural and horticultural crop species, the Phytotron can accommodate ecological investigations, plant biology problems of the space program, experimental taxonomy and air pollution studies as well as basic physiological, biochemical and plant molecular biology research. The Phytotron facility is available to the resident research staff, participants in graduate research programs of NC State and to domestic and foreign visiting scientists.

TRIANGLE UNIVERSITIES NUCLEAR LABORATORY (TUNL) - TUNL is a laboratory for structure research. Located on the campus of Duke University in Durham, the laboratory is staffed by faculty members and graduate students in the Departments of Physics of Duke University, UNC-Chapel Hill and NC State. There is extensive collaboration with personnel from the other two participating universities and with the many visiting physicists from the United States and abroad. Particle accelerators are used to bombard target nuclei with an assortment of ions of accurately controlled energy spread and spin orientation. The accelerators include a 15-MeV tandem Van de Graaff accelerator and a 4-MeV Van de Graaff accelerator. Polarized and pulsed beams are available as well as polarized targets. In addition, monoenergetic gamma ray

beams are produced by scattering free electron laser photons from electrons in an electron storage ring. TUNL physicists also perform experiments at major national and international nuclear physics facilities.

Special Programs

RESEARCH PROGRAM AT THE OAK RIDGE ASSOCIATED UNIVERSITIES - NC
State has been a sponsoring institution of Oak Ridge Associated Universities (ORAU) since 1949 and is one of six core universities along with ORAU and the University of Tennessee - Battelle Corporation that manage the Oak Ridge National Laboratory in Tennessee. ORAU is a private, not-for-profit consortium of 95 colleges and universities and a management and operating contractor for the U.S. Department of Energy (DOE) with principal offices located in Oak Ridge, Tennessee. Founded in 1946, ORAU provides and develops capabilities critical to the nation's technology infrastructure, particularly in energy, education, health, and the environment. ORAU works with and for its member institutions to help faculty and students gain access to federal research facilities; to keep members informed about opportunities for fellowship, scholarship and research appointments; and to organize research alliances among our members in areas where their collective strengths can be focused on issues of national importance.

ORAU manages the Oak Ridge Institute for Science and Education (ORISE) for DOE. ORISE is responsible for national and international programs in science and engineering education, training and management systems, energy and environment systems, and medical sciences. ORISE's competitive programs bring students at all levels, K-12 through postgraduate, and university faculty members into federal and private laboratories.

ORAU's Partnership Office seeks out opportunities for collaborative alliances among its member universities, private industry, and federal laboratories. Current alliances include the Southern Association for High Energy Physics (SAHEP) and the Center for Bio-Electromagnetic Interaction Research (CBEIR). Other UIGA activities include the sponsorship of conferences and workshops, the Visiting Scholars program and the Junior Faculty Enhancement Awards.

FIELDS OF INSTRUCTION

This section identifies and gives pertinent information about all the fields of study that participate in graduate education at NC State. There are a total of 98 different fields offering graduate degrees. In addition, there are eleven fields that offer minors at the graduate level and seven areas that support graduate education through offering graduate level courses or in some other capacity. Fields of instruction that offer graduate degrees are listed first. Information given for each field include the faculty, requirements for admission to and completion of the degree program(s), student financial support, courses offered and other relevant information. Following the degree offering fields is a listing other fields of instruction which offer graduate minors, graduate courses or support graduate education in some other way. To avoid duplication, basic Graduate School requirements for admission and completion of graduate degree programs are not repeated for each field of instruction. Only those requirements that are unique to the field are given in the sections on the individual fields. Graduate School requirements are summarized below.

BASIC GRADUATE SCHOOL REQUIREMENTS

Basic Requirements for Admission

Basic requirements for admission to the Graduate School include two official transcripts from all colleges and universities previously attended, references from at least three people who know of the student's academic record and potential for graduate study, a non-refundable application fee of \$55.00 for US Citizens and Permanent Residents or \$65.00 for Non-Resident Aliens (Internationals), Test of English as a Foreign Language (TOEFL) scores for students whose first language is not English, and, in most cases, an official statement of the student's Graduate Record Examination (GRE) scores and/or other standardized tests. The minimum paper-based TOEFL score, unless otherwise specified, is 550, with scores of at least 50 on at least two of the sections and no section score below 45. The minimum computer-based test score is 213, with at least 17 on two of the three sections and no section score below 13. The student's area of special interest may have additional requirements which are included in the individual program descriptions to follow.

Basic Requirements for Master's Degrees

A minimum of 30 semester credit hours is required for all master's degrees; however, many programs require more than thirty. Also, many students, in order to gain the breadth desired in their program or to make up deficits in their undergraduate degree, will actually take more credit hours than the minimum required by the program. At least 20 semester hours must come from 500- through 800-level courses. No more than two credit hours of departmental seminar may be included in the minimum 30-credit program. Programs that require a thesis may include no more than six hours of research credit (695) in the minimum 30-credit-hour program. Research credit is not appropriate in the non-thesis programs. Non-thesis programs may include no more than six hours of independent study credits in the minimum 30-credit program. Courses at the 400 level counted toward the minimal 30-hour requirement may not come from the major field. Master's thesis preparation (699) credits may not be used to satisfy the 30-credit-hour requirement.

Basic Requirements for Doctoral Degrees

The doctorate symbolizes the ability of the recipient to undertake original research and scholarly work at the highest levels without supervision. The degree is therefore not granted simply upon

completion of a stated amount of course work but rather upon demonstration by the student of a comprehensive knowledge and high attainment in scholarship in a specialized field of study. The student must demonstrate this ability by passing written and oral preliminary comprehensive examinations in the field of specialization and related areas of knowledge, where applicable, and by successfully defending the methodology used and conclusions reached in the research, as reported in the dissertation, in an open oral examination. In addition, the student must complete a minimum of 72 graduate credit hours beyond the bachelor's degree and meet the residence requirement as described earlier. For a student who has a master's degree, a maximum of 18 hours of relevant graduate credit from the master's degree may be applied toward this minimum upon the recommendation of the student's Graduate Advisory Committee. If a student completes a master's degree at NC State and continues for a doctoral degree without a break in time, up to 36 credit hours taken while in a master's status may be used to meet minimum requirements for the doctoral degree.

COURSES

The courses listed in this catalog are planned for the academic year 2001-02, unless otherwise indicated. Graduate-level courses are numbered at the 500, 600, 700 and 800 levels. Advanced undergraduates and persons holding baccalaureate degrees are eligible to enroll in 500- and 600-level courses, which are master's courses. Courses at the 700 and 800 level are doctoral courses and are open only to persons holding baccalaureate degrees. Exceptions may be made for undergraduate students in honors program and seniors in bachelor's/master's programs. Consent of the department is required for enrollment in all 600- and 800-level courses. Refer to the NC State University Courses Catalog for course descriptions and prerequisites.

Course Descriptions

For a description of courses being offered, either consult the Fields Offering Graduate Degrees in the Graduate Catalog or the course listings on the web.

Fields Offering Graduate Degrees

The Graduate School offers major programs of study in the following fields. Except where noted by an exception in parentheses, these programs required the Graduate Records Examination (GRE) scores and will not take action on applications unless accompanied by scores for at least the GRE General (Aptitude) Test (verbal, quantitative and analytical):

Accounting - MR (GMAT)

Adult and Community College Education - EdD, MS, MEd (GMAT, GRE or MAT)

Aerospace Engineering - PhD, MS (GRE)

Agency Counseling - MS, MEd (GRE or MAT)

Agricultural and Resource Economics - MS (GRE (required only if requesting financial aid))

Agricultural Education - MS, MR (GRE or MAT)

Animal Science - PhD, MS, MR (GRE)

Applied Mathematics - PhD, MS (GRE and GRE Subject Test)

Architecture - MR (GRE (exceptions apply; contact program))

Biochemistry - PhD, MS, MR (GRE)

Bioinformatics - PhD, MR (GRE)

Biological and Agricultural Engineering - PhD, MS, MR (GRE (exceptions apply; contact program))

Biomathematics - PhD, MS, MR (GRE)

Botany - PhD, MS, MR (GRE Writing Assessment Test)

Chemical Engineering - PhD, MS, MR (GRE)

Chemistry - PhD, MS, MR (GRE (not required but strongly encouraged))

Civil Engineering - PhD, MS, MR (GRE)

Communication - MS (GRE)

Comparative Biomedical Sciences - PhD, MS (GRE)

Computer Engineering - PhD, MS (GRE; TOEFL > 600 Internationals)

Computer Networking - MS (GRE and GRE Subject Test)

Computer Science - PhD, MS, MR (GRE and GRE Subject Test (MS & PhD); GRE (MR exceptions apply, contact program))

Counselor Education - PhD, MS, MEd (GRE or MAT)

Crop Science - PhD, MS, MR (GRE)

Curriculum and Instruction - PhD, MS, MEd (GRE (PhD); GRE or MAT (MEd and MS))

Curriculum and Instruction, Elementary Education - MS, MEd (GRE or MAT)

Curriculum and Instruction, English Education - MS, MEd (GRE or MAT)

Curriculum and Instruction, Reading - MS, MEd (GRE or MAT)

Curriculum and Instruction, Social Studies Education - MS, MEd (GRE or MAT)

Design - PhD (GRE)

Economics - PhD, MA, MR (GRE)

Educational Administration and Supervision - EdD (GRE or MAT)

Educational Research and Policy Analysis - PhD (GRE or MAT)

Electrical Engineering - PhD, MS (GRE; TOEFL > 600 Internationals)

Engineering (Off-campus, continental US residents and/or employees only) - MR (entrance exam not required)

English - MA (GRE general test)

Entomology - PhD, MS, MR (GRE)

Extension Education - MS, MR (GRE or MAT)

Fiber and Polymer Science - PhD (GRE)

Fisheries and Wildlife Sciences - MS, MR (GRE and GRE Subject Test (not required but strongly encouraged))

Food Science - PhD, MS, MR (GRE)

Forestry - PhD, MS, MR (GRE)

Functional Genomics - PhD, MS, MR (GRE)

Genetics - PhD, MS, MR (GRE)

Graphic Design - MR (GRE (exceptions apply; contact program))

Health Occupations Teacher Education - MS, MEd (GRE or MAT)

Higher Education Administration - MS, MEd, EdD (GMAT, GRE or MAT)

History - MA (GRE)

Horticultural Science - PhD, MS, MR (GRE)

Immunology - PhD, MS, MR (GRE)

Industrial Design - MR (GRE (not required but strongly encouraged))

Industrial Engineering - PhD, MS, MR (GRE)

Instructional Technology - Computers - MS, Med (GRE or MAT (MEd and MS))

Integrated Manufacturing Systems Engineering - MR (GRE (exceptions apply; contact program))

International Studies - MR (GRE)

Landscape Architecture - MR (GRE (not required but strongly encouraged))

Liberal Studies - MA (entrance exam not required)

Management - MS (GMAT)

Marine, Earth and Atmospheric Sciences - PhD, MS (GRE; GRE and GRE Subject Test for disciplines in Biological Oceanography and Geology)

Materials Science and Engineering - PhD, MS, MR (GRE (exceptions apply; contact program))

Mathematics - PhD, MS (GRE and GRE Subject Test (not required but strongly encouraged))

Mathematics Education - PhD, MS, MEd (GRE or MAT (MR); GRE (PhD))

Mechanical Engineering - PhD, MS, MR (GRE)

Microbiology - PhD, MS, MR (GRE)

Middle Grades Education - MS, MEd (GRE or MAT)

Natural Resources - MS, MR (GRE)

Nuclear Engineering - PhD, MS, MR (GRE (exceptions apply; contact program))

Nutrition - PhD, MS, MR (GRE)

Occupational Education - EdD, MS, MEd (GRE or MAT)

Operations Research - PhD, MS, MR (GRE)

Parks, Recreation and Tourism Management - PhD, MS, MR (GRE)
Physics - PhD, MS (GRE and GRE Subject Test)
Physiology - PhD, MS, MR (GRE)
Plant Pathology - PhD, MS, MR (GRE)
Poultry Science - MS, MR (GRE (not required but strongly encouraged))
Psychology - PhD (GRE and GRE Subject Test. MAT not required but strongly encouraged)
Public Administration - PhD, MR (GRE)
Public History - MA (GRE)

School Administration - MR (entrance exam not required)
Science Education - PhD, MS, MEd (GRE or MAT (MS, MEd); GRE (PhD))
Sociology - PhD, MS, MR (GRE)
Soil Science - PhD, MS, MR (entrance exam not required)
Special Education - MS, MEd (GRE and MAT)
Special Education, Behavior Disorders - MS, MEd (GRE or MAT)
Special Education, Learning Disabilities - MS, MEd (GRE or MAT)
Special Education, Mental Retardation - MS, MEd (GRE or MAT)
Specialized Veterinary Medicine - MS, MR (GRE)
Statistics - PhD, MS, MR (GRE)

Technical Communication - MS (GRE)
Technology Education - MS, MEd, EdD (GRE or MAT)
Textile and Apparel, Technology and Management - MS, MR (GRE)
Textile Chemistry - MS (GRE)
Textile Engineering - MS (GRE)
Textile Materials Science - MS, MR (GRE)
Textile Technology Management - PhD (GRE or GMAT)
Toxicology - PhD, MS, MR (GRE)
Training and Development - MS, MEd (GMAT, GRE or MAT)

Wood and Paper Science - PhD, MS, MR (GRE (exceptions apply; contact program))

Zoology - PhD, MS, MR (GRE and GRE Subject Test (not required but strongly encouraged))

Departments not normally requiring GRE scores may in special instances require their submission as additional information to be used in making a judgment of the student's potential for success in a graduate program.

Fields Offering Minors, Courses or Other Support to Graduate Programs

The following fields and units, while not offering graduate degrees, support graduate education by offering graduate minors and graduate courses or in some other capacity:

Anthropology
Artificial Intelligence
Biological Sciences
Biomedical Engineering
Biotechnology

Business Management
Computational Engineering and Sciences
Education
Food Safety
Foreign Languages and Literatures
Geographic Information Systems
Multidisciplinary Studies
Philosophy
Plant Physiology
Religion
Solid State Sciences
Water Resources
Women's and Gender Studies

Accounting

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Accounting					Y	

GRADUATE FACULTY

F. A. O. Buckless, *Head of the Department*

Director of Graduate Programs:

R. L. Peace, Box 8113, 515.4434, bob_peace@ncsu.edu

Peat Marwick Main Outstanding Professor: C. J. Messere

Professors: J. W. Bartley, P. F. Williams; **Associate Professors:** B. C. Branson, F. A. O. Buckless, Y. A. Chen, K. A. Krawczyk, R. L. McClenny-Wright, R. L. Peace, R. B. Sawyers, G. J. Zuckerman; **Assistant Professors:** M. S. Beasley, B. A. Chaney, L. R. Ingraham, J. G. Jenkins, D. P. Pagach

The Master of Accounting (MAC) is a professional degree designed to prepare students for careers as public accountants, internal auditors or tax specialists. Graduates will be prepared to complete the CPA Examination.

Admission Requirements: Successful applicants typically have a Graduate Management Admissions Test (GMAT) score above 500 and a 3.0 minimum undergraduate GPA. The best-qualified applicants will be accepted up to the number of spaces available for new students. Exceptions to the minimum GPA and GMAT score may be made because of the consideration given to other relevant factors. Prerequisite courses for admission to the master's program include accounting and certain other courses that are the equivalent of those required for an undergraduate degree in accounting. Applicants may receive provisional admission prior to completion of the prerequisites, but will not be admitted to 500-level courses until prerequisites are completed. Complete information and application forms can be obtained from the MAC Director.

Master's Degree Requirements: A minimum of 6 (maximum of 9) non-ACC credits are required. The curriculum is designed to provide a broad-based professional education.

Other Relevant Information: Master's students must begin the degree program in the summer or in the fall semester. The program is designed for full-time students and no night classes are offered.

In order to assure that an application will be considered for the next fall semester, all application forms, transcripts, applicable fees, resumes, letters of recommendation and other relevant material must be received no later than March 1.

GRADUATE COURSES

ACC 508 Advanced Commercial Law.
ACC 510 Advanced Financial Accounting
ACC 515 Accounting Theory and Current Issues.
ACC 519 Integrated Accounting Practice.
ACC 521 Production Cost Analysis and Control.
ACC 525 Advanced Management Accounting.
ACC 530 Advanced Income Tax.
ACC 533 Accounting and Tax Research Methodology.
ACC 534 Taxation of Corporations and Shareholders.
ACC 535 Taxation of Partnerships and S Corporations.
ACC 536 Taxation of Estates, Trusts and Gifts.
ACC 537 Tax Planning and Business Strategy.
ACC 550 Assessing Risks of Information Technology.
ACC 551 Advanced Auditing.
ACC 552 Advanced Accounting Cases.
ACC 580 Survey of Accounting
ACC 588 Special Topics in Accounting.
ACC 630 Independent Study.

Adult and Community College Education

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Adult and Community College Education		Y	Y			Y
Health Occupations Teacher Education			Y			Y
Higher Education Administration			Y	Y		Y
Training and Development				Y		Y

GRADUATE FACULTY

C. E. Kasworm, *Head of the Department*

Director of Graduate Programs:

J. C. Glass Jr., Box 7801, 515.6241, conrad_glass@ncsu.edu

Moore Distinguished Professor: G. A. Baker, III

Professors: J. C. Glass Jr., C. E. Kasworm, D. C. Locke, K. M. Moore, R. W. Shearon, G. B. Vaughan; *Visiting Professors:* K. M. Kolasa; *Professors Emeriti:* E. J. Boone, M. P. Burt, G. L. Carter Jr., M. W. Hoover, D. R. Proctor; *Associate Professors:* H. D. Akroyd, J. L. Burrow, W. Y. Lee; *Assistant Professors:* D. L. Martin, J. M. Pettitt, B. A. Sparks, S. W. Williams; *Visiting Assistant Professors:* M. J. Bresciani, C. C. Figuers, M. S. Hoover, V. S. Lee, D. C. Luckadoo, T. R. Luckadoo, B. I. Mallette, R. E. Parries, E. I. Schechter; *Adjunct Assistant Professors:* T. O'Driscoll

ASSOCIATE MEMBERS OF THE PROGRAM

Professors: R. D. Mustian; **Associate Professors:** R. T. Liles

The department offers degrees in adult and community college education, higher education administration and training and development to meet the professional needs of administrators, supervisors, specialists and instructors in community colleges, four-year colleges and universities, business and industry, the professions and other adult education organizations. Program concentrations include adult and continuing education, community college leadership and higher education, training and development, educational gerontology, and student affairs.

Admission Requirements: In addition to Graduate School admission requirements, the department requires the GRE, GMAT or Miller Analogies test. Specific information regarding admission can be obtained by contacting the Director of Graduate Programs.

Master's Degree Requirements: The M.S. and M.Ed. programs require a minimum of 30 or 36 credit hours, respectively. A graduate course in statistics and a thesis are required for the M.S.

Doctoral Degree Requirements: The Ed.D. program requires extensive research work and may include participation in a supervised internship experience. The doctoral program must be completed within seven years from the date of admission. One academic year of full-time residency is required.

Student Financial Support: A few graduate assistantships may be available to students in this program.

GRADUATE COURSES

EAC 602 Seminar in Adult and Community College Education.

EAC 624 Topical Problems in Adult and Community College Education.

EAC 640 Research Seminar in Adult and Community College Education.

EAC 641 Practicum in Health Occupations.

EAC 651 Internship in Adult and Community College Education.

EAC 685 Master's Supervised Teaching.

EAC 692 Master's Research Project.

EAC 693 Master's Supervised Research.

EAC 695 Master's Thesis Research.

EAC 696 Summer Thesis Research.

EAC 699 Master's Thesis Preparation.

EAC 700 Community College and Two-year Postsecondary Education.

EAC 701 Administrative Concepts and Theories Applied to Adult and Community College Education.

EAC 703 The Programming Process in Adult and Community College Education.

EAC 704 Leadership in Higher and Community College Education.

EAC 705 Group Process in Adult and Community College Education.

EAC 706 The College and University Presidency.

EAC 707 The Politics of Higher Education.

EAC 708 Continuing Education for the Professions.

EAC 710 Adult Education: History, Philosophy, Contemporary Nature

EAC 716 History of Higher Education in the United States

EAC 717 Current Issues in Higher Education.

EAC 720 Use of Secondary Survey Data in Adult and Higher Education.

EAC 732 Health Care Delivery Systems and Environments

EAC 735 Curriculum and Instruction in the Health Professions.

EAC 736 Issues and Trends in Education for the Health Professions

EAC 737 The Extension and Public Service Function in Higher Education.
EAC 738 Instructional Strategies in Adult and Community College Education.
EAC 739 Educational Gerontology.
EAC 743 Adulthood and Learning: The Later Years.
EAC 745 Death and Dying: A Lifespan Issue.
EAC 749 Finance in Adult and Community College Education.
EAC 750 The Environment for Learning in Adult and Community College Education
EAC 759 The Adult Learner.
EAC 765 Current Issues in Adult Education.
EAC 767 Education of Special Adult Populations.
EAC 778 Law and Higher Education.
EAC 779 Concepts and Principles of Evaluation Applied to Non-formal Adult Education Programs.
EAC 780 Designing Instructional Systems in Training and Development.
EAC 781 Advanced Instructional Design in Training and Development.
EAC 782 Organization and Operation of Training and Development Programs.
EAC 783 Needs Assessment and Task Analysis in Training and Development.
EAC 784 Evaluating Training Transfer and Effectiveness.
EAC 785 Qualitative Research in Adult and Community College Education.
EAC 786 Methods and Techniques of Training and Development
EAC 787 Organizational Concepts and Theories Applied to Adult and Community College Education.
EAC 788 Integrating Technology into Training Programs
EAC 789 Marketing for Education and Training Programs.
EAC 790 Advanced Qualitative Research Methods.
EAC 802 Research Seminar in Adult and Community College Education.
EAC 803 Research Seminar in Adult and Higher Education.
EAC 824 Topical Problems in Adult and Community College Education.
EAC 841 Practicum In Health Occupations.
EAC 851 Internship in Adult and Community College Education.
EAC 885 Doctoral Supervised Teaching.
EAC 890 Doctoral Preliminary Examination.
EAC 892 Doctoral Research Project.
EAC 893 Doctoral Supervised Research.
EAC 895 Doctoral Dissertation Research.
EAC 896 Summer Dissertation Research.
EAC 899 Doctoral Dissertation Preparation.

Aerospace Engineering

For a listing of graduate faculty and program information, see mechanical and aerospace engineering.

Agency Counseling

For a listing of graduate faculty and program information, see educational research, leadership and counselor education.

Agricultural and Extension Education

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Agricultural Education			Y		Y	
Extension Education			Y		Y	

GRADUATE FACULTY

J. L. Flowers, *Head of the Department*

Director of Graduate Programs:

G. E. Moore, Box 7607, 515.1756, gary_moore@ncsu.edu

Professors: G. W. Bostick Jr., J. M. Groff, D. M. Jenkins, B. M. Kirby, T. T. McKinney, G. E. Moore, R. D. Mustian, R. W. Shearon; **Adjunct Professors:** J. S. Lee; **Associate Professors:** J. L. Flowers, R. T. Liles; **Associate Professors Emeriti:** C. D. Bryant, T. R. Miller; **Assistant Professors:** D. B. Croom, E. B. Wilson

The agricultural and extension education department provides for advanced study for professionals in agricultural education, extension education or related careers. Programs of study may be designed to meet the individual needs of the student. Courses may be selected that lead to advanced teacher licensure in agriculture or an emphasis in extension education leading to advancement in careers in the Cooperative Extension Service. Additional specialization in the student's teaching or extension field is provided through a minor or advised elective courses. A number of the courses are Internet-based.

Admission Requirements: In addition to the Graduate School admission requirements, the department requires either GRE or the Miller's Analogies Test (MAT) scores (M.S. only), three positive references, and a statement of career goals and/or research interests. An interview (personal or by telephone) may be required.

Master's Degree Requirements: The department offers an M. S. degree, which requires a thesis for which the student receives six hours of credit and a Master of Agricultural Education and a Master of Extension Education as a non-thesis track. All master's degree programs require a total of 36 credit hours. Minors are optional but, if selected, require a minimum of nine credit hours.

Doctoral Degree Requirements: The multidisciplinary doctoral programs in occupational education is administered by the department and offers a specialization in agricultural and extension education. Contact the Director of Graduate Programs for details.

Student Financial Support: A limited number of research and/or teaching assistantships are available on a competitive basis. Other financial aid is available on a competitive basis from the

Graduate School.

GRADUATE COURSES

- AEE(ED) 501 Foundations of Agricultural and Extension Education.
AEE 521 Planning Programs in Agricultural Education.
AEE 522 Occupational Experience in Agriculture.
AEE 523 Adult Education in Agriculture.
AEE 524 Agricultural Occupations
AEE(ED) 530 Priority Management in Agricultural and Extension Education.
AEE 534 Supervision in Agricultural Education.
AEE(ED) 535 Teaching Agriculture in Secondary Schools.
AEE 595 Special Topics in Agricultural and Extension Education.
AEE 601 Seminar.
AEE 610 Special Topics
AEE 611 Special Topics in Agricultural Communications.
AEE 620 Special Problems.
AEE(ED) 641 Practicum in Agricultural and Extension Education.
AEE 685 Master's Supervised Teaching.
AEE 690 Master's Examination.
AEE 693 Master's Supervised Research.
AEE 695 Master's Thesis Research.
AEE 696 Summer Thesis Research.
AEE 699 Master's Thesis Preparation.
AEE(ED) 735 Effective Teaching in Agriculture and Life Sciences.
AEE 740 Extension in Developing Countries.
AEE 820 Special Problems.
AEE(ED) 841 Practicum in Agricultural and Extension Education.
AEE 885 Doctoral Supervised Teaching.
AEE 893 Doctoral Supervised Research.
AEE 895 Doctoral Dissertation Research.
AEE 896 Summer Dissertation Research.
AEE 899 Doctoral Dissertation Preparation.

Agricultural and Resource Economics - see economics

Agricultural Education - see agricultural and extension education

Animal Science

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Animal Science	Y		Y		Y	

GRADUATE FACULTY

K. L. Esbenshade, *Head of the Department*

Director of Graduate Programs:

E. J. Eisen, Box 7621, 515.4017, gene_eisen@ncsu.edu

William Neal Reynolds Professor: E. J. Eisen

Professors: B. P. Alston-Mills, L. S. Bull, J. C. Cornwell, R. G. Crickenberger, J. H. Eisemann, K. L. Esbleshade, W. L. Flowers, R. L. McCraw, B. T. McDaniel, R. M. Petters, O. W. Robison, J. W. Spears, L. W. Whitlow; **Visiting Professors:** R. E. McDowell, D. E. Pritchard; **Professors Emeriti:** K. R. Butcher, E. V. Caruolo, D. G. Davenport, R. W. Harvey, W. L. Johnson, E. E. Jones, J. R. Jones, C. A. Lassiter, J. M. Leatherwood, J. G. Lecce, R. D. Mochrie, R. M. Myers, A. H. Rakes, H. A. Ramsey, F. D. Sargent, F. H. Smith, J. C. Wilk, G. H. Wise; **Associate Professors:** C. E. Farin, B. A. Hopkins, W. E. M. Morrow, J. Odle, M. H. Poore, M. T. See, S. P. Washburn; **Adjunct Associate Professors:** M. T. Coffey; **Associate Professors Emeriti:** E. U. Dillard, J. J. McNeill; **Assistant Professors:** S. L. Ash, V. Fellner, R. J. Harrell, G. B. Huntington, J. A. Moore, K. Rozeboom, E. van Heugten, T. A. van Kempen, C. S. Whisnant; **Visiting Assistant Professors:** J. P. Cassady

ASSOCIATE MEMBERS OF THE PROGRAM

Professors: G. W. Almond, W. M. Hagler, Jr., D. K. Larick; **Professors (USDA):** J. C. Burns; **Associate Professors:** G. A. Benson, M. D. Whitacre; **Assistant Professors:** J. Luginbuhl, C. M. Williams

Animal science offers an opportunity for training in a diversity of basic sciences and the integration of such knowledge into the framework of a living system. Students may major or co-major in animal science or one of the following disciplines: biochemistry, genetics, microbiology, nutrition, physiology or statistics. Students may also concentrate in management and production areas.

Admission Requirements: Factors considered for admission include: grade point average, scores on the GRE (for M.S. and Ph.D. applicants), undergraduate courses, letters of recommendation and a member of the Animal Science Department faculty willing to serve as the applicant's advisor.

Master of Science: The minor is optional but external faculty representation is not required on the advisory committee.

Doctoral Degree Requirements: Majors in animal science do not have specific course requirements. Each student's course program is developed in consultation with the Ph.D. advisory committee. The minor is optional but external faculty representation is required on the advisory committee.

Student Financial Support: The department offers a limited number of half-time research assistantships on a competitive basis. To be eligible for support, applicants must have a minimum grade point average of 3.2.

Other Relevant Information: To provide an opportunity for students to develop their teaching skills, all graduate students are required to assist in the departmental teaching program, regardless of source of financial support.

GRADUATE COURSES

ANS 500 Advanced Ruminant Nutrition.
ANS(NTR) 516 Animal Nutrition Research Methods.
ANS 520 International Livestock Production.
ANS(NTR) 550 Applied Ruminant Nutrition.
ANS 553 Growth and Development of Domestic Animals.
ANS(FS, NTR) 554 Lactation and Milk Consumption.
ANS 590 Special Topics.
ANS 60/801 Animal Science Seminar.
ANS(CBS,PHY,ZO) 602 Seminar in Biology of Reproduction.
ANS 603/803 Reproductive Physiology Seminar.
ANS 604/804 Animal Breeding and Genetics Seminar.
ANS 610 Special Topics.
ANS 641/841 Practicum in Animal Science.
ANS 685 Master's Supervised Teaching.
ANS 690 Master's Examination.
ANS 693 Master's Supervised Research.
ANS 695 Master's Thesis Research.
ANS 696 Summer Thesis Research.
ANS 699 Master's Thesis Preparation.
ANS(PHY) 702 Reproductive Physiology of Mammals.
ANS 706 Mammalian Embryo Manipulation.
ANS(GN) 708 Genetics of Animal Improvement.
ANS(NTR) 709 Energy Metabolism.
ANS 710 Advanced Livestock Management.
ANS(GN) 713 Quantitative Genetics and Breeding.
ANS(CBS,NTR,PHY) 764 Comparative Physiology of the Digestive System.
ANS(NTR,PO) 775 Mineral Metabolism.
ANS(PHY) 780 Mammalian Endocrinology.
ANS(NTR) 785 Digestion and Metabolism in Ruminants.
ANS 790 Advanced Special Topics.
ANS 801/601 Animal Science Seminar.
ANS(CBS,PHY,ZO) 802 Seminar in Biology of Reproduction.
ANS 803/603 Reproductive Physiology Seminar.
ANS 804/604 Animal Breeding and Genetics Seminar.
ANS 810 Special Topics.
ANS 841/641 Practicum in Animal Science.
ANS 885 Doctoral Supervised Teaching
ANS 890 Doctoral Preliminary Examination.
ANS 893 Doctoral Supervised Research.
ANS 895 Doctoral Dissertation Research.
ANS 896 Summer Dissertation Research.
ANS 899 Doctoral Dissertation Preparation.

Applied Mathematics

For a listing of graduate faculty and program information, see mathematics.

Architecture

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Architecture					Y	

GRADUATE FACULTY

F. A. Rifki, *Head of the Department*

Director of Graduate Programs:

J. P. Rand, Box 7701, 515.8319, archgrad_design@ncsu.edu

Graduate Alumni Distinguished Professor: H. Sanoff

Professors: P. Batchelor, G. Bizios, R. P. Burns Jr., R. H. Clark, M. J. Malecha, J. W. Place, P. Tesar; **Professors Emeriti:** G. J. P. Reuer; **Associate Professors:** F. C. Harmon, J. P. Rand, F. A. Rifki, J. O. Tector; **Visiting Associate Professors:** H. McKinnon; **Associate Professors Emeriti:** D. W. Barnes Jr.; **Assistant Professors:** G. P. Borden, W. H. Redfield; **Visiting Assistant Professors:** J. Amundson

The Department of Architecture offers three tracks to the Master of Architecture degree: Track 1 is for applicants with a four-year undergraduate degree in architecture and may be completed in two years of full-time study. Track 2 is for applicants holding a five-year NAAB-accredited Bachelor of Architecture degree and normally requires three semesters in residence. Track 3 is for students with degrees in fields other than architecture. This track normally requires four semesters of pre-preparatory work before entering the final two-year program of graduate study. Some applicants with design-related academic or professional experience may be able to complete the preparatory work in less than four semesters. Curriculum requirements for the M.Arch. degree are held to a minimum in order to permit students the necessary flexibility to achieve individual educational and professional goals.

A variety of courses are available within the Department of Architecture in urban and community design, architectural history and theory, methods and programming, architectural conservation, professional practice, building technology and environmental systems.

Admission Requirements: In addition to documents required by the Graduate School, students apply to the Master of Architecture program by submitting the following documents by January 15: 1. Portfolio of work; 2. Completed Personal Data Form; 3. GRE scores (Track 3 applicants only); 4. TOEFL scores (foreign language students only). Applicants will be considered on an individual basis. Exceptions to Graduate School policy may be made for students indicating other qualifications and professional experience.

Master's Degree Requirements: The department stipulates the minimum course credits based on educational and professional goals to individualize a plan of study.

Student Financial Support: The department awards a number of scholarships, awards, and teaching and research assistantships competitively. It also supports national and statewide scholarships, fellowships, and awards. There are a number of tuition remissions and waivers permitting out-of-state students to pay in-state tuition and in-state students to pay no tuition, respectively.

National Architectural Accrediting Board (NAAB): The NAAB requires that the following statement be included in the catalogs of all accredited programs: In the United States, most state registration boards require a degree from an accredited professional degree program as a prerequisite for licensure. The National Architectural Accrediting Board (NAAB), which is the sole agency authorized to accredit U.S. professional degree programs in architecture, recognizes two types of degrees: the Bachelor of Architecture and the Master of Architecture. A program may be granted a five-year, three-year, or two-year term of accreditation, depending on its degree of conformance with established educational standards.

Master's degree programs may consist of a pre-professional undergraduate degree and a professional graduate degree, which, when earned sequentially, comprise an accredited professional education. However, the pre-professional degree is not, by itself, recognized as an accredited degree.

GRADUATE COURSES

- ARC 501 Professional Architecture Studio I.
- ARC 502 Professional Architecture Studio II
- ARC 503 Advanced Architectural Design (Series).
- ARC 531 The Chair as an Architectural Artifact.
- ARC 543 Analysis of Precedent.
- ARC 544 Architectural Conservation
- ARC 546 Theory of Building Types.
- ARC 551 Design Methods and Programming.
- ARC 561 The Practice of Architecture
- ARC 570 Anatomy of the City.
- ARC 571 The Urban House.
- ARC 573 Environmental Perception.
- ARC 574 Place and Place Making.
- ARC 575 Participatory Design in Architecture.
- ARC 576/DDN 776/LAR 576 Community Design.
- ARC 577/DDN 777/LAR 577 Sustainable Communities.
- ARC 581 Project Preparation Seminar.
- ARC 589 Architectural Travel Study II.
- ARC 598 Final Project Studio in Architecture
- ARC 610 Special Topics.
- ARC 630 Independent Study.
- ARC 676 Special Project.
- ARC 697 Final Research Project.

Biochemistry

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Biochemistry	Y		Y		Y	

GRADUATE FACULTY

D. T. Brown, *Head of the Department*

Director of Graduate Programs:

D. T. Brown, Box 7622, 515.5802, dbrown@bchserver.bch.ncsu.edu

William Neal Reynolds Professor: W. L. Miller

Professors: P. F. Agris, D. T. Brown, L. K. Hanley-Bowdoin, E. S. Maxwell, E. C. Sisler, P. L. Wollenzien; **Adjunct Professors:** K. S. Korach, E. C. Theil; **Professors Emeriti:** F. B. Armstrong, L. W. Aurand, H. R. Horton, J. S. Kahn, I. S. Longmuir; **Associate Professors:** C. C. Hardin, C. L. Hemenway, J. A. Knopp; **Assistant Professors:** C. Mattos; **Visiting Assistant Professors:** A. C. Clark, A. White

ASSOCIATE MEMBERS OF THE PROGRAM

Professors: R. R. Sederoff, H. E. Swaisgood, H. M. Hassan, J. W. Moyer, D. E. Sayers

The graduate program in biochemistry is designed to prepare individuals for careers in research and teaching. Emphasis is primarily focused on laboratory research, where graduate students work closely with faculty. The department is well equipped to conduct research in biochemistry, biophysics, molecular biology and molecular genetics.

Admission Requirements: Students entering the graduate program in biochemistry should have a bachelor's degree in biochemistry, chemistry or a related physical or biological science, including undergraduate courses in organic chemistry, calculus, physics and one year of physical chemistry, as well as biochemistry/molecular biology.

Master of Science Degree Requirements: Up to 6 of the 30 credits required may be earned in laboratory rotations (BCH 670) and thesis research (BCH 695). On average, completion of the M.S. degree requires 2 to 3 years.

Doctoral Degree Requirements: Requirements for the Ph.D. degree include a minimum of 30 credit hours in course work and thesis research, including at least two advanced courses in biochemistry/ molecular biology; teaching experience. Formal course work may be completed within three semesters; on average, completion of the Ph.D. degree requires 5 years.

Student Financial Support: The department endeavors to meet the financial needs of students

accepted into its doctoral program. Essentially all admitted students are offered the opportunity to apply for graduate teaching and research assistantships.

Other Relevant Information: The Department of Biochemistry is jointly administered by the Colleges of Agriculture and Life Sciences and Physical and Mathematical Sciences. The department, committed to a strong research environment, interacts with other life science departments on campus as well with the other research universities and institutes of the Research Triangle area.

GRADUATE COURSES

BCH 552 Experimental Biochemistry.
BCH 553 Metabolism and Molecular Biology.
BCH 601 Seminar.
BCH 610 Special Topics.
BCH 615 Advanced Special Topics
BCH(TOX) 660 Free Radicals in Toxicology.
BCH 670 Laboratory Rotations.
BCH 685 Master's Supervised Teaching.
BCH 690 Master's Examination.
BCH 693 Master's Supervised Research.
BCH 695 Master's Thesis Research.
BCH 696 Summer Thesis Research.
BCH 699 Master's Thesis Preparation.
BCH 701 Macromolecular Structure.
BCH 703 Macromolecular Synthesis and Regulation.
BCH 705 Molecular Biology of the Cell.
BCH 751 Biophysical Chemistry.
BCH(GN) 761 Advanced Molecular Biology of the Cell.
BCH 763 Biochemistry of Hormone Action.
BCH(GN) 768 Nucleic Acids: Structure and Function.
BCH 801 Seminar.
BCH 810 Special Topics.
BCH 815 Advanced Special Topics
BCH(TOX) 860 Free Radicals in Toxicology
BCH 870 Laboratory Rotations.
BCH 885 Doctoral Supervised Teaching.
BCH 890 Doctoral Preliminary Examination.
BCH 893 Doctoral Supervised Research.
BCH 895 Doctoral Dissertation Research.
BCH 896 Summer Dissertation Research.
BCH 899 Doctoral Dissertation Preparation.

Bioinformatics

For a listing of graduate faculty and program information, see genomic sciences.

Biological and Agricultural Engineering

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Biological and Agricultural Engineering	Y		Y		Y	

GRADUATE FACULTY

J. H. Young, *Head of the Department*

Director of Graduate Programs:

D. H. Willits, Box 7625, 515.6755, dan_willits@ncsu.edu

Distinguished University, Graduate Alumni Distinguished, and Wm. Neal Reynolds Professor:

R. W. Skaggs

Professors: C. F. Abrams Jr., J. C. Barker, D. B. Beasley, R. W. Bottcher, C. G. Bowers Jr., M. D. Boyette, F. J. Humenik, E. G. Humphries, R. P. Rohrbach, A. R. Rubin, R. S. Sowell, L. F.

Stikeleather, P. W. Westerman, D. H. Willits, J. H. Young; **Professors (USDA):** T. B. Whitaker;

Adjunct Professors: L. M. Safley, L. M. Sykes; **Professors Emeriti:** H. D. Bowen, J. W. Dickens, L. B. Driggers, W. H. Johnson, G. J. Kriz, W. F. McClure, F. M. Richardson, R. E. Sneed, C. W. Suggs, E. H. Wiser; **Associate Professors:** G. R. Baughman, S. M. Blanchard, R. O. Evans Jr., S. A. Hale, R. L. Huffman, G. D. Jennings, J. E. Parsons, G. T. Roberson; **Visiting Associate Professors:** J. D. Spooner; **Assistant Professors:** J. Cheng, J. J. Classen, G. L. Grabow, P. L. Mente; **Research Assistant Professors:** D. M. Amatya, G. M. Chescheir, S. K. Liehr; **Senior Researchers:** S. C. Mohapatra

ASSOCIATE MEMBERS OF THE PROGRAM

Professors: K. R. Swartzel, A. E. Hassan, T. M. Losordo; **Associate Professors:** B. E. Farkas, S. C. Roe; **Assistant Professors:** C. R. Daubert, K. M. Keener, K. P. Sandeep

Course offerings or research facilities are available in the following areas: bioinstrumentation, biomechanics, human engineering, bioprocessing, food packaging and processing, biological systems modeling, aquaculture, hydrology, water table management, ground water management, animal waste management, non-point source pollution, power and machinery, soil and water, structures and environment, food and process engineering, electrical and electronic systems, forest mechanization, robotics and machine vision.

Admission Requirements: A baccalaureate in biological or agricultural engineering or the equivalent is the preferred prerequisite for admission. Those with strong academic background in the physical or biological sciences may also be admissible with a requirement for certain additional background undergraduate work. In the case of applicants with master's degrees, a master's GPA of at least 3.2 is required for admission. Exceptions to the overall undergraduate GPA requirements may be made for cases where performance in the major or during the last two

years was at or above the 3.00 level.

GRE scores are recommended for those with academic performance records near the minimal level. Applicants without engineering degrees from domestic accredited institutions must submit GRE scores to be considered for admission. Admission decisions are made by a faculty review committee. The best-qualified applicants will be accepted up to the number of spaces available for new students.

Master's Degree Requirements: (M.BAE): This non-thesis degree requires 33 hours of approved graduate course work and a directed special project which must be comprised from 3-6 hours credit. A minor is required. (M.S.): A minor is required.

Doctoral Degree Requirements: Course hour requirements are flexible but typically include at least 36 hours beyond a master's degree. Direct admission without a master's is possible in exceptional cases. A minor is required.

Student Financial Support: Graduate assistantships are available to students in this program on a competitive basis.

GRADUATE COURSES

BAE 501 Instrumentation and Control for Biological Systems.

BAE(CBS) 522 Mechanics of Biological Materials.

BAE 572 Irrigation and Drainage.

BAE(SSC) 573 Hydrologic and Water Quality Modeling.

BAE(CE) 578 Agricultural Waste Management.

BAE 585 Bioelectricity.

BAE 590 Special Topics in Biological and Agricultural Engineering.

BAE 601 Seminar.

BAE 610 Special Topics.

BAE 620 Special Problems.

BAE 685 Master's Supervised Teaching.

BAE 690 Master's Examination.

BAE 693 Master's Supervised Research

BAE 695 Master's Thesis Research.

BAE 696 Summer Thesis Research.

BAE 699 Master's Thesis Preparation.

BAE 752 Instrumentation for Agricultural Research and Processing.

BAE(SSC) 771 Theory of Drainage--Saturated Flow.

BAE(SSC) 774 Theory of Drainage--Unsaturated Flow.

BAE(SSC) 780 Transport and Fate of Chemicals in Soils and Natural Waters.

BAE(FS) 785 Food Rheology.

BAE 790 Special Topics in Biological and Agricultural Engineering.

BAE 801 Seminar.

BAE 810 Special Topics.

BAE 820 Special Problems.

BAE 885 Doctoral Supervised Teaching.

BAE 890 Doctoral Preliminary Examination.

BAE 893 Doctoral Supervised Research.

BAE 895 Doctoral Dissertation Research.

BAE 896 Summer Dissertation Research.

BAE 899 Doctoral Dissertation Preparation.

Biomathematics

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Biomathematics	Y		Y		Y	

GRADUATE FACULTY

Director of Graduate Programs:

K. H. Pollock, Box 8203, 515.1957, pollock@stat.ncsu.edu

Burroughs Wellcome Distinguished Professor: J. E. Riviere

University Professor and Drexel Professor: H. T. Banks

William Neal Reynolds Professor: B. S. Weir

Professors: T. M. Gerig, J. F. Gilliam, T. Johnson, K. H. Pollock, H. E. Schaffer, J. F. Selgrade, R. E. Stinner, G. G. Wilkerson; **Research Professors:** S. Zeng; **Professors Emeriti:** J. W. Bishir, H. J. Gold, R. J. Monroe, H. R. Van Der Vaart; **Associate Professors:** S. M. Blanchard, C. E. Smith, J. L. Thorne, H. T. Tran; **Assistant Professors:** T. C. Elston, N. M. Haddad, G. R. Hess, T. B. Kepler, S. R. Lubkin, S. V. Muse

ASSOCIATE MEMBERS OF THE PROGRAM

Adjunct Professors: L. B. Crowder

Biomathematics is an interdisciplinary graduate program offering courses and research opportunities in basic and applied mathematical biology. Degree programs are flexible to accommodate students with backgrounds in the biological, mathematical or physical sciences. The program also offers Ph.D. and master's-level minors. A brochure with additional information on requirements, courses, faculty and current research can be obtained by writing the program director.

Admission Requirements: Applicants should have either a bachelor's degree in biology with evidence of aptitude and interest in mathematics, or a bachelor's in a mathematical science with evidence of aptitude and interest in biology. Advanced (multivariate) calculus, linear algebra and general biology are prerequisites for all BMA courses, and deficiencies in these should be remedied during the first year of graduate study. The application must include a narrative statement (1-2 pages) of the applicant's goals and reasons for interest in the BMA program.

Master's Degree Requirements: The M.S. and M.BMA. degrees require BMA 567 or 774, 771-772; 2 upper-level biology courses; and three courses from the mathematical sciences or statistical sciences. The M.S. degree requires a thesis, and the M.BMA. requires two additional courses and a written project.

Doctoral Degree Requirements: Course requirements consist of a "core" and a "concentration"

in some area of biology or mathematical sciences. Core requirements are: BMA 771-772, 773 and 774; three upper-level biology courses from at least two areas (e.g., physiology and evolution); and additional courses from the mathematical or statistical sciences. Concentration consists of either a Ph.D. co-major in a biological or mathematical science or a coherent series of five graduate courses approved by the student's committee, which must include a two-semester sequence and at least one 700-level course.

Financial Assistance: TAs (generally in the Department of Statistics), RAs and internships are available. Awards are based on GRE scores, transcripts and letters of recommendation. RAs usually are held by continuing students. To receive full consideration for financial aid, the completed application must be received by

March 1.

Other Relevant Information: All students are required to participate in the BMA Graduate Seminar. Course requirements can be met by examination or by demonstrating that an equivalent course was completed at another university.

GRADUATE COURSES

BMA 567 Modeling of Biological Systems.
BMA 573 Mathematical and Experimental Modeling of Physical Processes I.
BMA 574 Mathematical and Experimental Modeling of Physical Processes II.
BMA 590 Special Topics.
BMA 610 Special Topics.
BMA 685 Master's Supervised Teaching.
BMA 690 Master's Examination.
BMA 693 Master's Supervised Research.
BMA 695 Master's Thesis Research.
BMA 696 Summer Thesis Research.
BMA 699 Master's Thesis Preparation.
BMA(OR,ST) 722 Decision Analytic Modeling.
BMA(MA,ST) 771 Biomathematics I
BMA(MA,ST) 772 Biomathematics II.
BMA(MA,OR,ST) 773 Stochastic Modeling
BMA(MA,OR) 774 Partial Differential Equation Modeling in Biology.
BMA 790 Special Topics.
BMA 801 Seminar
BMA 815 Advanced Special Topics.
BMA 885 Doctoral Supervised Teaching.
BMA 890 Doctoral Preliminary Examination.
BMA 893 Doctoral Supervised Research.
BMA 895 Doctoral Dissertation Research.
BMA 896 Summer Dissertation Research.
BMA 899 Doctoral Dissertation Preparation.

Botany

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Botany	Y		Y		Y	

GRADUATE FACULTY

M. E. Daub, *Head of the Department*

Director of Graduate Programs:

N. S. Allen, Box 7612, 515.8382, nina_allen@ncsu.edu

University Research Professor: W. F. Thompson

Professors: N. S. Allen, U. Blum, W. F. Boss, R. S. Boston, W. S. Chilton, E. Davies, R. C. Fites,

J. F. Thomas, C. G. Van Dyke, T. R. Wentworth; ***Professors (USDA):*** H. E. Pattee; ***Professors Emeriti:***

C. E. Anderson, J. W. Hardin, W. W. Heck, R. L. Mott, G. R. Noggle, E. D. Seneca, J. R. Troyer; ***Associate Professors:*** R. L. Beckmann, J. M. Burkholder, J. E. Mickle, D. Robertson, J.

M. Stucky; ***Adjunct Associate Professors:*** C. S. Brown

ASSOCIATE MEMBERS OF THE PROGRAM

Professors: M. M. Goodman, T. W. Rufty, Jr., E. C. Sisler, E. A. Wheeler; ***Professors (USDA):*** S.

C. Huber; ***Associate Professors:*** H. V. Amerson, R. W. Whetten; ***Associate Professors (USDA):***

K. O. Burkey; ***Assistant Professors:*** M. D. Purugganan

Course offerings or research facilities are available in the following areas: molecular biology, cell biology and physiology of development; calcium, the cytoskeleton and signal transduction; biochemistry of crown gall; physiological ecology of freshwater, marine and terrestrial plants; community ecology; wetland plants; plant systematics; ultrastructure.

Admission Requirements: In special situations, students with an undergraduate GPA of less than 3.00 (on a 4.00 scale) may be admitted provisionally. If students lack certain prerequisites (e.g., in mathematical, chemical, biological or other areas), additional courses may be required that do not qualify for graduate credit. The best qualified students will be accepted when spaces are available for new students.

Master's and Doctoral Degree Requirements: Courses from each of the two sub-disciplines (cell and molecular biology and ecology biodiversity) are required. Students must earn a letter grade of at least a "B" in these courses. Other requirements include: a graduate statistics course, a thesis (for the Ph.D. and M.S., but not the Master of Botany), a comprehensive examination (Ph.D.), oral thesis defense and a one-semester teaching responsibility per degree.

Other Relevant Information: Graduate research and teaching assistantships and tuition remission information are available from the department. Graduate students are expected to attend and participate in the seminar program every semester they are in residence. The department is host to several training grants in plant cell and molecular biology founded by the Tri-Agency (NSF,DOE,USDA) and NASA.

GRADUATE COURSES

BO(MB,PP) 501 Fungi and Their Interaction with Plants.

BO 544 Plant Geography.

BO 565 Plant Community Ecology.

BO(MB,PP) 575 Introduction to Mycology.
BO 601 Botany Seminar.
BO 620 Special Problems.
BO 624 Topical Problems.
BO 685 Master's Supervised Teaching.
BO 690 Master's Examination.
BO 693 Master's Supervised Research.
BO 695 Master's Thesis Research.
BO 696 Summer Thesis Research.
BO 699 Master's Thesis Preparation.
BO 710 Plant Anatomy.
BO 712 Plant Morphogenesis.
BO(CS,HS) 718 Biological Control of Weeds.
BO 722 Advanced Morphology and Phylogeny of Seed Plants.
BO(GN,MB,PP) 730 Fungal Genetics and Physiology.
BO 731 Water Relations of Plants.
BO 733 Plant Growth and Development.
BO 745 Paleobotany.
BO 751 Advanced Plant Physiology I.
BO 752 Advanced Plant Physiology II.
BO 754 Laboratory in Advanced Plant Physiology II.
BO(ZO) 760 Principles of Ecology.
BO 761 Physiological Ecology.
BO 762 Applied Coastal Ecology.
BO(ZO) 770 Advanced Topics in Ecology I.
BO(MB) 774 Phycology.
BO(MB,PP) 775 The Fungi.
BO(MB,PP) 776 The Fungi-Lab.
BO 780 Plant Molecular Biology.
BO 801 Botany Seminar.
BO 820 Special Problems.
BO 824 Topical Problems.
BO 885 Doctoral Supervised Teaching.
BO 890 Doctoral Preliminary Examination.
BO 893 Doctoral Supervised Research.
BO 895 Doctoral Dissertation Research.
BO 896 Summer Dissertation Research.
BO 899 Doctoral Dissertation Preparation.

Chemical Engineering

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Chemical Engineering	Y		Y		Y	

GRADUATE FACULTY

P. K. Kilpatrick, *Head of the Department*

Director of Graduate Programs:

S. A. Khan, Box 7905, 515.4519, khan@eos.ncsu.edu

Camille Dreyfus Professor: H. B. Hopfenberg

Distinguished University Professor: D. F. Ollis

Graduate Alumni Distinguished Professor: C. K. Hall

Hoechst-Celanese Professor: R. G. Carbonell

W. H. Clark Distinguished Professor: K. E. Gubbins

William R. Kenan Jr. Distinguished Professor and Mary Ann Smith Professor: J. M. DeSimone

Professors: K. J. Bachmann, P. S. Fedkiw, B. D. Freeman, R. M. Kelly, P. K. Kilpatrick, P. K. Lim, M. R. Overcash, G. W. Roberts, C. J. Setzer; **Research Professors:** J. J. Spivey; **Visiting Professors:** M. O. Aboelfotoh; **Adjunct Professors:** I. Pinna, M. E. Stewart; **Professors Emeriti:** R. M. Felder, J. K. Ferrell, A. S. Michaels, V. T. Stannett; **Associate Professors:** C. S. Grant, S. A. Khan, H. H. Lamb, G. N. Parsons, S. W. Peretti, R. J. Spontak, H. M. Winston; **Assistant Professors:** J. Genzer, J. M. Haugh, J. H. van Zanten

ASSOCIATE MEMBERS OF THE PROGRAM

Professors: H. Jameel; **Associate Professors:** C. M. Balik

Research activities in the department include: biochemical engineering, catalysis and reaction engineering, computer-aided design and manufacturing, electronic materials, electrochemical engineering, environmental engineering; polymer science and engineering, thermodynamics and computer simulation, and transport phenomena.

Admissions Requirements: Students admitted to the graduate program normally have a bachelor's degree in chemical engineering or its equivalent. Students with undergraduate degrees in chemistry, physics or other engineering disciplines may be admitted but will be required to make up undergraduate course work deficiencies in chemical engineering without graduate credit. The most promising candidates will be accepted up to the number of spaces available.

Master of Science Degree Requirements: A set of five core courses is strongly recommended. The thesis must be defended in a final public oral examination.

Master of Chemical Engineering Degree Requirements: A three-credit project is required. A set of five core courses is strongly recommended.

Doctor of Philosophy Degree Requirements: Students normally take a set of five core courses, two advanced chemical engineering courses and at least 6 credits of dissertation research. A thesis is required; this must be defended in a final public oral examination. In addition, the candidate must: (1) submit and defend an original written proposition in any area of chemical engineering, and (2) submit and defend a proposal to perform his/her thesis research.

GRADUATE COURSES

CHE 525 Process System Analysis and Control.

CHE(OR) 527 Optimization of Engineering Processes.

CHE 543 Polymer Science and Technology.

CHE 546 Design and Analysis of Chemical Reactors

CHE 551 Biochemical Engineering

CHE 560 Chemical Processing of Electronic Materials.

CHE 565 Diffusion in Polymers.

CHE 575 Advances in Pollution Prevention: Environmental Management.

CHE(NE) 585 Management of Hazardous Chemical and Radioactive Wastes.
CHE 596 Special Topics.
CHE 597 Special Projects.
CHE 601 Seminar.
CHE 610 Special Topics.
CHE 685 Master's Supervised Teaching.
CHE 690 Master's Examination.
CHE 693 Master's Supervised Research.
CHE 695 Master's Thesis Research.
CHE 696 Summer Thesis Research.
CHE 699 Master's Thesis Preparation.
CHE 711 Chemical Engineering Process Modeling.
CHE 713 Thermodynamics I.
CHE 714 Thermodynamics II.
CHE 715 Transport Phenomena I.
CHE 716 Transport Phenomena II.
CHE 717 Chemical Reaction Engineering.
CHE 718 Advanced Chemical Reaction Engineering.
CHE 719 Electrochemical Systems Analysis.
CHE 721 Separation Processes.
CHE 752 Separation Processes for Biological Materials.
CHE 760 Photochemical Engineering: Fundamentals and Applications.
CHE(MAT) 761 Polymer Blends and Alloys.
CHE(TC) 769 Polymers, Surfactants and Colloidal Materials.
CHE 779 Diffusion in Polymers.
CHE 796 Special Topics in Chemical Engineering.
CHE 797 Chemical Engineering Projects.
CHE 798 Advanced Chemical Engineering Projects.
CHE 801 Seminar.
CHE 810 Special Topics.
CHE 885 Doctoral Supervised Teaching.
CHE 890 Doctoral Preliminary Examination.
CHE 893 Doctoral Supervised Research.
CHE 895 Doctoral Dissertation Research.
CHE 896 Summer Dissertation Research.
CHE 899 Doctoral Dissertation Preparation.

Chemistry

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Chemistry	Y		Y		Y	

GRADUATE FACULTY

B. M. Novak, *Head of the Department*

Director of Graduate Programs:

E. F. Bowden, Box 8204, 515.7069, edmond_bowden@ncsu.edu

Glaxo Distinguished University Professor: J. S. Lindsey

Professors: A. J. Banks, R. D. Bereman, E. F. Bowden, C. L. Bumgardner, H. H. Carmichael, D. L. Comins, B. E. Eaton, M. A. Fox, K. W. Hanck, F. C. Hentz Jr., M. G. Khaledi, S. G. Levine, C. G. Moreland, B. M. Novak, J. G. Osteryoung, R. A. Osteryoung, S. T. Purrington, A. F. Schreiner, G. H. Wahl Jr., M. H. Whangbo, J. K. Whitesell, J. L. Whitten; **Professors Emeriti:** L. D. Freedman, F. W. Getzen, R. H. Loepert, W. P. Tucker, R. C. White; **Associate Professors:** C. B. Boss, T. C. Caves, C. B. Gorman, J. D. Martin, D. A. Shultz, W. L. Switzer, B. Wang, D. W. Wertz; **Assistant Professors:** D. L. Feldheim, S. Franzen, T. B. Gunnoe, M. T. Oliver-Hoyo, A. I. Smirnov, T. I. Smirnova, J. L. White

ASSOCIATE MEMBERS OF THE PROGRAM

Associate Professors: D. W. Brenner

The Department of Chemistry offers programs of study leading to the Doctor of Philosophy, Master of Science and Master of Chemistry degrees. The Ph.D. and M.S. degrees are based on original research, while the Master of Chemistry degree is a non-research degree. Many research projects merge disciplines such as biochemistry, computational science, materials science, physics, statistics and toxicology with chemistry. General courses as well as advanced and special topics courses are offered.

Admission Requirements: Applicants should have an undergraduate degree in chemistry or in a closely related field with a strong chemistry background. A GPA of at least 3.0 in the sciences is needed for consideration. GRE General Test scores are strongly recommended, and the Subject Test is recommended. Admission decisions are made as completed applications are received. For most favorable consideration for the fall term, all application materials should be received by March 1; for spring admission, by August 15.

Master's Degree Requirements: The requirements for a Master of Chemistry degree are 27 hours of course work, 3 hours of a critical review paper and an oral examination on the review paper. Students in this program should have present or past experience in a research laboratory. The M.S. degree in chemistry requires 27 hours of course work and research leading to completion of a thesis.

Doctoral Degree Requirements: In the doctoral program, emphasis is placed on original research and a comprehensive knowledge of one's chosen field.

Student Financial Support: Incoming graduate students are supported by departmental teaching assistantships. Outstanding applicants are eligible for supplemental fellowships during their first year of study. Research assistantships are normally available to second-, third-, and fourth-year students. The department also has fellowships for students interested in the area of electronic materials, biotechnology and pharmaceutical and synthetic organic chemistry.

Other Relevant Information: The Department of Chemistry is one of five academic departments in the College of Physical and Mathematical Sciences. Several new faculty have been added in the last few years, thereby enhancing opportunities for graduate research.

GRADUATE COURSES

- CH 601 Seminar.
CH 610 Special Topics.
CH 615 Advanced Special Topics.
CH 677 Advanced Chemistry Projects.
CH 685 Master's Supervised Teaching.
CH 690 Master's Examination.
CH 693 Master's Supervised Research.
CH 695 Master's Thesis Research.
CH 696 Summer Thesis Research.
CH 699 Master's Thesis Preparation.
CH 701 Advanced Inorganic Chemistry I.
CH 703 Advanced Inorganic Chemistry II.
CH 705 Physical Methods in Inorganic Chemistry.
CH(MAT) 707 Chemical Concepts in Materials Science and Engineering.
CH 711 Advanced Analytical Chemistry I.
CH 713 Advanced Analytical Chemistry II.
CH 714 Electronics and Instrumentation Laboratory.
CH 715 Chemical Instrumentation.
CH 717 Physical Methods of Elemental Trace Analysis.
CH 718 Trace Analysis Laboratory.
CH 721 Advanced Organic Chemistry I.
CH 723 Advanced Organic Chemistry II.
CH 725 Physical Methods in Organic Chemistry.
CH 727 Mass Spectrometry.
CH 730 Advanced Physical Chemistry.
CH 731 Chemical Thermodynamics I.
CH 733 Chemical Kinetics.
CH 736 Chemical Spectroscopy.
CH 737 Quantum Chemistry.
CH 739 Colloid Chemistry.
CH 741 Analytical Spectroscopy.
CH 743 Electrochemistry.
CH 745 Chemical Separation.
CH 755 Organic Reaction Mechanisms.
CH 757 Chemistry of Metal-organic Compounds.
CH 759 Natural Products.
CH(MAT,TC) 762 Physical Chemistry of High Polymers--Bulk Properties.
CH(MAT,TC) 772 Physical Chemistry of High Polymers--Solution Properties.
CH 801 Seminar.
CH 810 Special Topics.
CH 815 Advanced Special Topics.
CH 877 Advanced Chemistry Projects.
CH 885 Doctoral Supervised Teaching.
CH 890 Doctoral Preliminary Examination.
CH 893 Doctoral Supervised Research.
CH 895 Doctoral Dissertation Research.
CH 896 Summer Dissertation Research.
CH 899 Doctoral Dissertation Preparation.

Civil Engineering

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Civil Engineering	Y		Y		Y	

GRADUATE FACULTY

E. D. Brill Jr., *Head of the Department*

Director of Graduate Programs:

D. W. Johnston, Box 7908, 515.7412, johnston@eos.ncsu.edu

Distinguished Professor: S. H. Rizkalla

Professors: M. A. Barlaz, R. C. Borden, R. H. Borden, E. D. Brill Jr., J. S. Fisher, A. K. Gupta, D. W. Johnston, N. P. P. Khosla, Y. R. Kim, H. R. Malcom Jr., J. M. Nau, W. J. Rasdorf, N. M.

Rouphail; **Adjunct Professors:** L. E. King, K. H. Reckhow; **Professors Emeriti:** M. Amein, P. D. Cribbins, R. A. Douglas, J. F. Ely, J. M. Hanson, K. S. Havner, C. L. Heimbach, Y. Horie, J. W.

Horn, A. I. Kashef, P. H. McDonald Jr., S. W. Nunnally, C. C. Tung, H. E. Wahls, P. Z. Zia;

Associate Professors: J. W. Baugh Jr., L. E. Bernold, W. L. Bingham, A. C. Chao, H. C. Frey, M. A. Gabr, J. E. Hummer, M. L. Leming, V. C. Matzen, M. F. Overton, M. S. Rahman, S. R.

Ranjithan, J. R. Stone, A. A. Tayebali; **Adjunct Associate Professors:** D. R. van der Vaart;

Associate Professors Emeriti: E. D. Gurley, J. C. Smith; **Assistant Professors:** F. L. de los Reyes III, J. J. Ducoste, M. N. Guddati, A. Gupta, T. Hassan, D. R. Knappe, M. J. Kowalsky, N.

Krstulovic, G. Mahinthakumar; **Research Assistant Professors:** D. H. Loughlin

Graduate programs are offered in coastal and ocean engineering, computer-aided engineering, construction engineering and management, environmental and water resources engineering, geotechnical engineering, structures and mechanics, transportation engineering and materials.

Admission Requirements: Provisional admission may be granted to applicants who do not satisfy normal admission criteria but have other special qualifications. Applicants without academic experience in civil engineering may be required to take undergraduate courses to remove deficiencies, without graduate credit. The Graduate Record Examination normally is required of all applicants.

Master's Degree Requirements: (M.CE.): The M.CE. is an Option B non-thesis degree with other requirements, such as independent projects or core courses, specified in some areas of specialization. At least two-thirds of a master's program should be in a well-defined major area of concentration. A formal minor is not permitted. (M.S.): A thesis is required and a formal minor is optional.

Doctoral Degree Requirements: The Ph.D. typically requires one year of full-time course work beyond the master's degree and research culminating in a dissertation. The program must develop

a well-defined major area of concentration and may include supporting courses outside the major or a formal minor in a related field.

Student Financial Support: Departmental teaching and research assistantships are available including coverage of tuition and health insurance. Fellowships supplementing the assistantships, which may include coverage of academic fees, are available for exceptional U. S. applicants. All financial aid recipients are selected on merit-based competition with other applicants. Applications requesting financial aid should be received by March 1 for Fall admission and by September 1 for Spring admission.

GRADUATE COURSES

- CE 501 Transportation Systems Engineering.
- CE 502 Traffic Operations.
- CE 503 Highway Design.
- CE 504 Airport Planning and Design.
- CE 505 Advanced Airport Systems Design.
- CE 509 Highway Safety.
- CE 521 Structural Models.
- CE 522 Theory and Design of Prestressed Concrete.
- CE 523 Theory and Behavior of Steel Structures.
- CE 524 Analysis and Design of Masonry Structures.
- CE(WPS) 528 Structural Design in Wood.
- CE 537 Computer Methods and Applications.
- CE 538 Information Technology and Modeling.
- CE 548 Engineering Properties of Soils I.
- CE 549 Soil and Site Improvement.
- CE 561 Construction Project Management.
- CE 564 Legal Aspects of Contracting.
- CE 571 Theory of Water and Waste Treatment.
- CE 572 Design of Water and Wastewater Facilities.
- CE 574 Chemistry and Microbiology for Engineers I.
- CE 576 Engineering Principles of Air Pollution Control.
- CE 577 Engineering Principles of Solid Waste Management.
- CE 580 Flow in Open Channels.
- CE 583 Engineering Aspects of Coastal Processes.
- CE 584 Hydraulics of Ground Water.
- CE 586 Engineering Hydrology.
- CE 588 Water Resources Engineering.
- CE 590 Special Topics in Civil Engineering.
- CE 591 Special Topics in Civil Engineering Computing.
- CE 592 Special Topics in Construction Engineering.
- CE 593 Special Topics in Geotechnical Engineering.
- CE 594 Special Topics in Structural Mechanics.
- CE 595 Special Topics in Transportation Engineering.
- CE 596 Special Topics in Water Resources and Environmental Engineering
- CE 601 Civil Engineering Seminar.
- CE 602 Seminar in Civil Engineering Computing.
- CE 603 Seminar in Construction Engineering.
- CE 604 Seminar in Geotechnical Engineering.
- CE 605 Seminar in Structural Mechanics.
- CE 606 Seminar in Transportation Engineering.
- CE 607 Seminar in Water Resources and Environmental Engineering.
- CE 635 Advanced Reading in Civil Engineering.
- CE 675 Civil Engineering Projects.
- CE 685 Master's Supervised Teaching.
- CE 693 Master's Supervised Research.
- CE 695 Master's Thesis Research.
- CE 696 Summer Thesis Research.

CE 699 Master's Thesis Preparation.
CE 701 Urban Transportation Planning.
CE 702 Traffic Flow Theory.
CE 705 Intelligent Transportation Systems.
CE 706 Advanced Traffic Control.
CE 713 Theory of Elasticity I.
CE 714 Stress Waves.
CE 715 Advanced Strength of Materials.
CE 717 Theory of Plates and Shells.
CE 718 Plasticity and Limit Analysis.
CE 719 Finite Deformation of Materials I.
CE 720 Matrix and Finite Element Structural Analysis I.
CE 721 Matrix and Finite Element Structural Analysis.
CE 722 Structural Dynamics.
CE 723 Advanced Structural Dynamics.
CE 724 Probabilistic Methods of Structural Engineering.
CE 725 Earthquake Structural Engineering.
CE 726 Advanced Theory of Concrete Structures
CE 737 Computer-aided Engineering Systems.
CE 741 Advanced Soil Mechanics.
CE 742 Advanced Soil Mechanics.
CE 744 Foundation Engineering
CE 746 Dynamics of Soils and Foundations.
CE 751 Theory of Concrete Mixtures.
CE 753 Asphalt and Bituminous Materials.
CE 755 Highway Pavement Design.
CE 757 Pavement Management Systems.
CE 759 Inelastic Behavior of Construction Materials.
CE 761 Design of Temporary Structures.
CE 762 Construction Productivity.
CE 763 Materials Management in Construction.
CE 765 Construction Equipment Systems.
CE 766 Building Construction Systems.
CE 771 Advanced Water and Waste Treatment: Principles and Design.
CE 773 Hazardous Waste Management and Treatment.
CE 774 Chemistry and Microbiology for Engineers II.
CE 775 Modeling and Analysis of Environmental Systems.
CE 776 Advanced Water Management Systems.
CE(MEA) 779 Advanced Air Quality.
CE 781 Behavior and Analysis of Ocean Structures.
CE 782 Coastal Hydrodynamics.
CE 783 Design of Coastal Facilities.
CE 784 Ground Water Contaminant Transport.
CE 785 Urban Stormwater Management.
CE 790 Advanced Topics in Civil Engineering.
CE 791 Advanced Topics in Civil Engineering Computing
CE 792 Advanced Topics in Construction Engineering.
CE 793 Advanced Topics in Geotechnical Engineering
CE 794 Advanced Topics in Structural Mechanics.
CE 795 Advanced Topics in Transportation Engineering.
CE 796 Advanced Topics in Water Resources and Environmental Engineering
CE 801 Civil Engineering Seminar.
CE 802 Seminar in Civil Engineering Computing
CE 803 Seminar in Construction Engineering.
CE 804 Seminar in Geotechnical Engineering.
CE 805 Seminar in Structural Mechanics.
CE 806 Seminar in Transportation Engineering
CE 807 Seminar in Water Resources and Environmental Engineering.
CE 839 Advanced Reading in Civil Engineering.
CE 885 Doctoral Supervised Teaching.
CE 890 Doctoral Preliminary Examination.
CE 893 Doctoral Supervised Research.

CE 895 Doctoral Dissertation Research.
CE 896 Summer Dissertation Research.
CE 899 Doctoral Dissertation Preparation.

Communication

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Communication			Y			

GRADUATE FACULTY

R. Entman, *Head of the Department*

Director of Graduate Programs:

W. J. Jordan, Box 8104, 515.9757, jordan@social.chass.ncsu.edu

Professors: L. R. Camp, R. Entman, W. J. Jordan, L. W. Long, R. L. Schrag; **Associate Professors:** D. A. DeJoy, E. T. Funkhouser, V. J. Gallagher, M. Javidi, R. Leonard, B. L. Russell;

Assistant Professors: D. P. Dannels, C. R. Hullett, J. K. Jameson, M. A. Johnson, J. Macoubrie, S. R. Stein, T. L. Taylor

The Master of Science program in communication is designed to provide graduate-level expertise for solving problems in modern organizations and social systems from a communication perspective and addresses issues concerned with interpersonal, relational and technologically mediated communication systems essential to modern, networked organizations and societies. Its graduates will acquire advanced-level expertise in communication theory, research and applications that will improve processes and enhance outcomes within and across diverse social systems and will prepare them for higher-level managerial positions in their professions.

Admission Requirements: Applicants should have a minimum 3.0 GPA in the undergraduate major and a minimum of 3.0 over the last 60 hours of undergraduate work.

Master's Degree Requirements: The degree requires 36 credit hours with a minimum of 27 credit hours taken in communication; up to 9 hours may be taken outside of the department with the approval of the graduate advisor. Students will be required to complete 12 hours in communication theory, 6 hours in communication research methods and 9 hours in applied communication courses. They will also be required to complete 9 hours as electives to be chosen from among the first three groups of courses or up to 9 hours of electives may be taken outside the department with the approval of the graduate advisor.

GRADUATE COURSES

COM(ENG) 514 History of Rhetoric.
COM(ENG) 516 Rhetorical Criticism: Theory and Practice
COM 556 Seminar in Organizational Communication.

COM 561 Human Communication Theory.
 COM 566 Seminar in Crisis Communication.
 COM 598 Special Topics in Communication.
 COM 630 Independent Study.
 COM 685 Master's Supervised Teaching.
 COM 690 Master's Examination.
 COM 693 Master's Supervised Research.

Comparative Biomedical Sciences

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Comparative Biomedical Sciences	Y		Y			
Specialized Veterinary Medicine			Y		Y	

GRADUATE FACULTY

Director of Graduate Programs:

G. Cole, Box 8401, 513.6220, gregory_cole@ncsu.edu

Burroughs Wellcome Distinguished Professor: J. E. Riviere

Graduate Alumni Distinguished Professor: K. B. Adler, W. A. F. Tompkins

Professors: G. W. Almond, K. L. Anderson, R. A. Argenzio, A. L. Aronson, C. E. Atkins, H. J. Barnes, E. B. Breitschwerdt, T. T. Brown Jr., C. F. Brownie, S. E. Bunch, P. B. Carter, G. Cole, J. M. Cullen, E. V. De Buysscher, D. J. DeYoung, L. N. Fleisher, O. J. Fletcher Jr., R. B. Ford, F. J. Fuller, C. Grindem, J. S. Guy, T. E. Hamm Jr., B. Hammerberg, M. G. Levy, D. H. Ley, D. J. Meuten, N. A. Monteiro-Riviere, E. J. Noga, N. C. Olson, P. E. Orndorff, W. D. Oxender, L. E. Perryman, M. C. Roberts, P. L. Sannes, J. E. Smallwood, E. A. Stone, M. K. Stoskopf, L. P. Tate Jr., C. Teng, D. E. Thrall, M. B. Tompkins; **Research Professors:** M. C. McGahan; **Visiting Professors:** E. A. Havell; **Adjunct Professors:** G. R. Burleson, R. L. Cooper, M. W. Dewhirst, J. Fine, E. Gilboa, J. N. Kornegay, J. N. MacCormack, R. R. Maronpot, P. Nettesheim, M. J. Selgrade, F. Welsch; **Professors Emeriti:** E. G. Batte, P. J. Bentley, H. A. Berkhoff, L. Coggins, T. M. Curtin, R. C. Dillman, D. M. Hanson, D. R. Howard, J. K. Magor, D. J. Moncol, J. E. Newbold, C. E. Stevens; **Associate Professors:** P. Arasu, S. A. Bai, K. F. Bowman, B. A. Breuhaus, D. G. Bristol, P. Cowen, M. G. Davidson, L. A. Degernes, R. E. Fish, K. Flammer, J. E. Gadsby, B. Gilger, E. M. Hardie, E. C. Hawkins, L. C. Hudson, E. Hunt, B. W. Keene, J. F. Levine, G. A. Lewbart, N. E. Love, M. B. McCaw, R. E. Meyer, M. G. Papich, B. P. Peters, C. L. Robinette, S. C. Roe, B. Sherry, B. D. Slenning, I. W. Smoak, K. A. Spaulding, C. R. Swanson, S. L. Tonkonogy, S. L. Vaden, J. Vaillancourt, S. D. Van Camp, D. P. Wages, M. D. Whitacre; **Research Associate Professors:** T. L. Goldsworthy, J. M. Horowitz, S. Kennedy-Stoskopf; **Visiting Associate Professors:** R. W. Litaker; **Adjunct Associate Professors:** J. C. Bonner, G. A. Boorman, B. E. Butterworth, D. Dixon, K. L. Dreher, T. E. Eling, G. A. Erickson, J. Everitt, P. M. D. Foster, T. R. Fox, M. R. Loomis, P. C. Mann, E. E. McConnell, K. T. Morgan, R. L. Peiffer Jr., J. A. Raleigh, J. M. Rhoads, D. C. Richardson, R. J. Smialowicz, C. T. Teng; **Assistant Professors:** C. Altier, M. J. Burkhard, M. T. Correa, G. A. Dean, P. W. Farin, S. Y. Gardner, W.

A. Horne, H. A. Jackson, M. W. Jackson, S. L. Jones, J. M. Law, D. E. Malarkey, D. J. Marcellin, K. G. Mathews, A. M. Miles, K. R. Munana, B. Nwadike, T. Olivry, D. M. Ruslander, N. J. H. Sharp, S. L. Vivrette; **Research Assistant Professors:** J. B. Allen, R. E. Baynes, A. T. Blikslager, C. A. Harms, M. L. Hauck, L. D. Martin, C. W. Pitulle; **Clinical Assistant Professors:** W. R. Redding; **Visiting Assistant Professors:** R. V. English, B. D. Hansen, R. Linnehan; **Adjunct Assistant Professors:** D. J. Darr, B. J. Davis, D. C. Dorman, H. Jordan, S. H. Randell, R. Regnery, M. E. Stebbins; **Electron Microscopy Director:** M. J. Dykstra

ASSOCIATE MEMBERS OF THE PROGRAM

Professors: W. J. Croom, Jr., M. A. Qureshi; **Professors Emeriti:** J. R. Harris; **Associate Professors:** J. M. Hinshaw, S. M. Laster, W. E. M. Morrow; **Adjunct Associate Professors:** R. R. Miller; **Assistant Professors:** S. Branch

Course offerings and research topics currently include, but are not limited to: immunology, cardiology, pharmacokinetics, oncology, toxicology, gastroenterology, neurophysiology, reproductive physiology, biotechnology, microbiology, aquatic/ wildlife biology, biomedical engineering, endocrinology, molecular biology, pulmonary biology, epidemiology, population medicine, health systems monitoring, transplantation and radiology.

Admission Requirements: All applications are reviewed by the Graduate Student Admissions Committee of the College, composed of faculty members representing each area of the graduate program. Scores from the GRE are required for admission by all applicants. Candidates who do not have a DVM degree must have a baccalaureate degree or advanced degree from a college or university recognized as standard by a regional or general accrediting agency. Students with a 3.0 (on a 4.0 scale) undergraduate or DVM curriculum with appropriate course background will be considered for admission.

Doctoral Degree Requirements: Credit hour requirements for the Ph.D. degree are determined by the graduate student's committee with approval of the Director of Graduate Programs and the Graduate School.

Student Financial Support: Research assistantships are awarded to qualified candidates on the competitive basis by the College. These are for 12-month periods, and stipends are competitive with those of other programs. These positions are funded by the grants of individual faculty members and the state appropriations to the College and departments.

Other Relevant Information: The program is organized across traditional departmental lines as areas of concentration which include: cell biology/morphology, epidemiology/ population medicine, microbiology, pathology and pharmacology. These provide extensive interdisciplinary training and maintain a highly effective liaison with graduate programs in other schools of the university, as well as those of nearby Duke University and the University of North Carolina at Chapel Hill.

GRADUATE COURSES

CBS(BAE) 522 Mechanics of Biological Materials.
CBS(ANS,PHY,ZO) 602 Seminar in Biology of Reproduction.
CBS 610 Special Topics.
CBS 685 Master's Supervised Teaching.

CBS 690 Master's Examination.
CBS 693 Master's Supervised Research.
CBS 695 Master's Thesis Research.
CBS 696 Summer Thesis Research.
CBS 699 Master's Thesis Preparation.
CBS 730 Veterinary Histology.
CBS 731 Applied Veterinary Anatomy I.
CBS 732 Electron Microscopy in Veterinary Medicine.
CBS 740 Research Animal Care and Use.
CBS 742 Advanced Systemic Histopathology.
CBS 743 Toxicologic Pathology I.
CBS 751 Pathogenic Bacteriology and Mycology.
CBS 752 Diagnostic Bacteriology and Mycology.
CBS 753 Veterinary Immunology.
CBS 754 Principles of Analytical Epidemiology.
CBS(IMM) 755 Immunoparasitology.
CBS(IMM, MB, PHY, PO) 756 Immunogenetics.
CBS 762 Principles of Pharmacology.
CBS(ANS,NTR,PHY) 764 Comparative Physiology of the Digestive System.
CBS 770 Cell Biology.
CBS 773 Advanced Developmental Biology.
CBS 774 Epidemiology of Infectious Diseases of International Importance.
CBS 780 Veterinary Production Epidemiology.
CBS 782 Marine Mammal Medicine.
CBS(MB) 783 Advanced Immunology.
CBS 785 Advanced Pharmacology.
CBS 787 Pharmacokinetics.
CBS 790 Special Topics in Clinical Pathology.
CBS(ANS,PHY,ZO) 802 Seminar in Biology of Reproduction.
CBS 803 Seminar in Surgical Pathology.
CBS 804 Seminar in Necropsy Pathology.
CBS 805 Seminar in Pharmacology.
CBS 806 Seminar in Cell Biology.
CBS(IMM) 807 Seminar in Veterinary Microbiology/ Immunology.
CBS 810 Special Topics.
CBS 812 Special Topics in Pathology.
CBS 813 Special Topics in Laboratory Pharmacology.
CBS 815 Advanced Topics in Virology.
CBS(IMM) 816 Advanced Topics in Immunology and Biotechnology.
CBS 817 Advanced Topics in Zoological Medicine I.
CBS 818 Advanced Topics in Zoological Medicine II.
CBS 860 Instrumentation in Pharmacological Research.
CBS 861 Bacterial Pathogenic Mechanisms.
CBS 862 Professional Conduct in Biomedical Research.
CBS 885 Doctoral Supervised Teaching.
CBS 890 Doctoral Preliminary Examination.
CBS 893 Doctoral Supervised Research.
CBS 895 Doctoral Dissertation Research.
CBS 896 Summer Dissertation Research.
CBS 899 Doctoral Dissertation Preparation.

Computer Engineering

For a listing of graduate faculty and program information, see electrical and computer engineering.

Computer Networking

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Computer Networking			Y			

GRADUATE FACULTY

Director of Graduate Programs:

E. W. Davis Jr., Box 8206, 515.7045, davis@csc.ncsu.edu, Computer Science

R. T. Kuehn, Box 7911, 515.5090, rkuehn@eos.ncsu.edu, Electrical and Computer Engineering

Distinguished University Professor: M. A. Rappa

Professors: S. H. Barr, W. Chou, G. W. Dickson, P. D. Franzon, T. K. Miller III, A. A. J. Nilsson, H. G. Perros, W. E. Snyder, K. Tai, J. K. Townsend, H. J. Trussell, M. A. V. Vouk; ***Associate Professors:*** D. L. Baumer, C. C. Bozarth, S. N. Chapman, M. Chow, T. M. Conte, B. L. Hughes, D. S. Reeves, G. N. Rouskas, M. P. Singh, I. Viniotis; ***Assistant Professors:*** A. I. Anton, J. B. Earp, V. E. Jones, J. K. McCreery, F. C. Payton, I. Rhee, P. R. Wurman

ASSOCIATE MEMBERS OF THE PROGRAM

Professors: W. J. Stewart

The Master of Science in computer networking may be earned through the M.S. with thesis option or through the non-thesis option. Either option may be used as preparation for further graduate study or employment in industrial research, development or design environment, although students planning to continue on for a Ph.D. should discuss the option selected with their advisors.

Admission Requirements: Students may apply for admission through either the Department of Computer Science or the Department of Electrical and Computer Engineering, and admissions criteria will adhere to those currently in place for the existing M.S. programs in those departments.

Master's Degree Requirements: Computer networking core courses constitute 9 of the 30 minimum credit hours. Students take 12 additional credit hours of computer networking courses from one of four currently defined technical concentration areas: network design, network hardware, network software or distributed computing. The remaining 9 credit hours may be taken from an approved management concentration sequence, as additional courses in the computer networking technical concentration or as 6 hours of thesis and 3 credit hours from the list of approved computer networking courses. At least 6 of the 30 credits must come from the 700 level, and non-letter graded courses such as individual studies courses may account for a maximum of 3 credit hours.

CORE COURSES

CSC(ECE) 570 Computer Networks.
CEC(ECE) 579 Computer Performance Modeling.
BUS 5xx Technology Management.

Computer Science

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Computer Science	Y		Y		Y	

GRADUATE FACULTY

A. L. Tharp, *Head of the Department*

Director of Graduate Programs:

E. W. Davis Jr., Box 8206, 515.7045, davis@csc.ncsu.edu

Distinguished University Research Professor: D. L. Bitzer

Professors: W. Chou, E. W. Davis Jr., R. J. Fornaro, R. E. Funderlic, D. F. McAllister, H. G. Perros, C. D. Savage, W. J. Stewart, K. Tai, A. L. Tharp, M. A. V. Vouk; *Adjunct Professors:* R. J. Plemmons; *Professors Emeriti:* D. C. Martin, W. E. Robbins; *Associate Professors:* D. R. Bahler, R. A. Dwyer, E. F. Gehring, T. L. Honeycutt, S. P. Iyer, J. C. Lester, D. S. Reeves, R. D. Rodman, G. N. Rouskas, M. P. Singh, M. F. M. Stallmann; *Adjunct Associate Professors:* W. R. Cleaveland II; *Assistant Professors:* A. I. Anton, C. G. Healey, V. E. Jones, W. Lee, I. Rhee, J. G. Rossie Jr., R. A. St. Amant, P. R. Wurman, R. M. Young; *Adjunct Assistant Professors:* M. Aparicio IV, G. Q. Kenney, L. A. Williams, A. O. Zaghloul; *Assistant Professors Emeriti:* J. W. Hanson, N. F. Williamson

ASSOCIATE MEMBERS OF THE PROGRAM

Professors: E. L. Kaltofen, C. D. Meyer, Jr., T. K. Miller, III, W. E. Snyder; *Associate Professors:* J. W. Baugh, Jr., J. S. Scroggs, I. Viniotis; *Assistant Professors:* G. Lazzi

The Department of Computer Science is changing rapidly to become a leader in the networked world. Recent developments include adding fourteen tenure-track faculty, six of whom received NSF CAREER development awards. Total research expenditures have tripled and graduate enrollments have climbed above 200 students. The faculty has broad-ranging research interests.

Admission Requirements: Successful applicants have an accredited baccalaureate degree with a B average, including computer science course work at least equivalent to a minor. Applicants must submit scores for the GRE General Tests and GRE Computer Science Subject Test. [Exception:

Applicants for the Master of Computer Science curriculum who do not desire financial aid may omit the Subject Test.]

Master's Degree Requirements: The M.S. requires two core courses and thesis research (typically six credits). The advisory committee may waive the thesis requirement for students who pass the Ph.D. written preliminary examination and complete specified course work in lieu of research. The Master of Computer Science (M.C.S.) is a terminal professional degree granted upon successful completion of 30 hours of course work, including three courses from the core list: CSC 501, CSC 505, CSC 506 and CSC 707.

Doctoral Degree Requirements: Ph.D. students normally complete 72 semester hours of post-baccalaureate course work. They must also complete core course work in three broad areas (theoretical foundations, software systems and architecture), individualized in-depth written and oral preliminary examinations, and a public defense of a dissertation describing substantial original, independent scholarly work.

Student Financial Support: A unique asset is the department's Industrial Assistantship Program, under which graduate students perform part-time work at local firms. During 1999-2000 approximately 85 students held traditional teaching and research assistantships. Outstanding candidates may receive fellowships or be employed at lecturers.

Other Relevant Information: Graduates at all levels are highly respected and well paid locally and elsewhere. Many M.S. and M.C.S. graduates begin or continue careers performing and supervising advanced software development in and around the Research Triangle Park. Many recent Ph.D.s assumed positions of technical leadership in well-known large companies or assumed tenure-track faculty positions.

GRADUATE COURSES

- CSC 501 Operating Systems Principles.
- CSC 505 Design and Analysis of Algorithms.
- CSC(ECE) 506 Architecture of Parallel Computers.
- CSC(ECE) 510 Software Engineering.
- CSC 512 Compiler Construction.
- CSC 513 Electronic Commerce Technology.
- CSC(ECE) 517 Object-oriented Languages and Systems
- CSC 520 Artificial Intelligence I.
- CSC 523 Computational Linguistics.
- CSC 530 Computational Methods for Molecular Biology.
- CSC 540 Database Management Concepts and Systems.
- CSC 541 Advanced Data Structures.
- CSC(IE) 546 Management Decision and Control Systems.
- CSC 550 Computer Graphics.
- CSC 554 Human-Computer Interaction.
- CSC(IE) 556 Voice Input/Output Communication Systems.
- CSC 557 Multimedia Computing and Networking
- CSC(MA,OR) 565 Graph Theory.
- CSC(ECE) 570 Computer Networks.
- CSC(ECE) 572 Introduction to Computer Communications.
- CSC(ECE) 573 Internetwork Protocols and Architectures.
- CSC 575 Network Security.
- CSC(ECE) 576 Telecommunications Systems Engineering.
- CSC(ECE,OR) 579 Introduction to Computer Performance Modeling
- CSC(MA) 580 Numerical Analysis I.
- CSC 591 Special Topics in Computer Science.

CSC 600 Computer Science Graduate Orientation.
CSC 630 Individual Study in Computer Science.
CSC 685 Master's Supervised Teaching.
CSC 690 Master's Examination.
CSC 693 Master's Supervised Research.
CSC 695 Master's Thesis Research.
CSC 696 Summer Thesis Research.
CSC 699 Master's Thesis Preparation.
CSC 707 Automata, Languages and Computability Theory.
CSC 714 Real Time Computer Systems.
CSC 715 Concurrent Software Systems.
CSC 720 Artificial Intelligence II.
CSC 723 Computational Semantics.
CSC 725 Intelligent Multimedia Systems.
CSC 742 Database Management Systems.
CSC(ECE) 748 Parallel Processing.
CSC(IE) 756 Advances in Voice Input/output Communications Systems.
CSC(OR,IE) 762 Computer Simulation Techniques.
CSC(ECE) 776 Performance Evaluation of Computer Networks.
CSC(ECE) 777 Telecommunications Network Design.
CSC(ECE) 779 Advanced Computer Performance Modeling.
CSC(MA) 780 Numerical Analysis II.
CSC(MA) 783 Parallel Algorithms and Scientific Computation.
CSC 791 Advanced Topics in Computer Science.
CSC 830 Advanced Individual Study in Computer Science.
CSC 885 Doctoral Supervised Teaching.
CSC 890 Doctoral Preliminary Examination.
CSC 893 Doctoral Supervised Research.
CSC 895 Doctoral Dissertation Research.
CSC 896 Summer Dissertation Research.
CSC 899 Doctoral Dissertation Preparation.

Counselor Education

For a listing of graduate faculty and program information, see educational research, leadership and counselor education.

Crop Science

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Crop Science	Y		Y		Y	

GRADUATE FACULTY

H. T. Stalker Jr., *Head of the Department*

Director of Graduate Programs:

D. A. Danehower, Box 7620, 515.3667, david_danehower@ncsu.edu

Distinguished University Professor and William Neal Reynolds Professor: M. M. Goodman

Philip Morris Professor: G. F. Peedin

William Neal Reynolds Professor: E. A. Wernsman

Professors: D. T. Bowman, A. H. Bruneau, F. T. Corbin, E. J. Dunphy, J. T. Green Jr., T. G. Isleib, H. M. Linker, R. C. Long, J. P. Mueller, J. P. Murphy, R. P. Patterson, C. H. Peacock, R. C. Ruffy, T. W. Ruffy Jr., W. D. Smith, H. T. Stalker Jr., J. B. Weber, W. W. Weeks, A. K. Weissinger, R. Wells, G. G. Wilkerson, J. C. Wynne, A. C. York; **Professors (USDA):** J. C. Burns, J. W. Burton, T. E. Carter Jr., E. L. Fiscus, S. C. Huber, J. E. Miller, R. F. Wilson; **Professors Emeriti:** C. A. Brim, B. E. Caldwell, D. S. Chamblee, J. F. Chaplin, H. D. Coble, W. K. Collins, W. A. Cope, D. A. Emery, W. T. Fike Jr., D. U. Gerstel, H. D. Gross, G. R. Gwynn, P. H. Harvey, G. L. Jones, J. A. Lee, W. M. Lewis, D. E. Moreland, H. Seltmann, G. A. Sullivan, D. L. Thompson, D. H. Timothy, J. A. Weybrew, A. D. Worsham; **Associate Professors:** D. C. Bowman, R. J. Cooper, D. A. Danehower, R. E. Dewey, K. L. Edmisten, G. P. Fenner, S. H. Kay, R. D. Keys, V. A. Sisson, J. F. Spears, J. W. Wilcut; **Associate Professors (USDA):** K. O. Burkey, P. Kwanyuen, D. P. Livingston III; **Assistant Professors:** R. W. Heiniger, D. L. Jordan, J. Luginbuhl, R. Qu, P. R. Weisz, F. H. Yelverton; **Assistant Professors (USDA):** J. B. Holland

ASSOCIATE MEMBERS OF THE PROGRAM

Professors: W. F. Thompson

The Department of Crop Science offers programs of study leading to the Master of Crop Science (M.C.S.), Master of Science (M.S.) and Doctorate of Philosophy (Ph.D.) degrees. The M.S. and Ph.D. programs are based upon original research while the M.C.S degree is a non-thesis degree program. Areas of study in the department include plant breeding, genetics and molecular biology; crop production, management, chemistry and physiology; sustainable agriculture and agro-ecology; turf grass management and science; integrated pest management, weed science and crop modeling.

Excellent facilities for graduate education are available, including wet and dry labs for preparation and analysis of plant and soil samples, cold storage facilities, greenhouses, controlled environmental chambers, computing facilities and the Southeastern Plant Environment Laboratories (Phytotron) for highly controlled plant environmental research. Agriculturally, North Carolina has a wide array of environments and soils for field research. This includes the sandy coastal plains and black lands of eastern NC, the central Piedmont with its clay soils, and the mountains of NC with their unique environments and soils. University and State research stations are located strategically throughout each of these regions and are widely used for field research.

Crop Science programs also benefit from strong cooperative ties with other departments and institutions. Graduate students in Crop Science work cooperatively with and/or obtain instruction in the Departments of Animal Science, Biochemistry, Botany, Chemistry, Computer Science, Entomology, Horticultural Science, Genetics, Mathematics, Microbiology, Plant Pathology, Soil Science and Statistics. Cooperative efforts link our programs with faculty at a number of land grant and international universities as well as with leaders in agribusiness and environmental protection.

Admissions Requirements: Prospective students should be graduates of an accredited university with a major in agronomy, animal science, biology, crop science, genetics, horticulture, plant science or related field of study. Graduates from other degree programs will be considered but

may be asked to make up certain undergraduate deficiencies. Acceptance of applicants is competitive and limited by program space and funding. Typically, an applicant should have a minimum of a 3.0 (out of 4.0) GPA and a minimum GRE score of 1000 on the verbal and analytical portions of the exam. Exceptions to these guidelines may be made for students with special backgrounds, abilities or interests

Master's Degree Requirements: *Master of Science Degree:* Requirements include one hour of Seminar (CS 601), six hours of Statistics (ST 501 and ST 701 or equivalent), completion of a thesis, a comprehensive oral examination and presentation of an exit seminar. *Master of Crop Science Degree:* M.C.S. requirements include a minimum of 36 semester hours of graduate work with a minimum of four, but no more than six, credit hours of Special Problems (CS 620). One hour of Crop Science Seminar (CS 601), three hours of Statistics (ST 501 or equivalent) and presentation of an exit seminar are also required.

Doctoral Degree Requirements: Ph.D. Candidates must demonstrate an ability to conduct original research and scholarly work at the highest level. Other requirements include one hour of Crop Science Seminar (CS 801) and an exit seminar. The crop physiology and weed science programs have additional "core" course requirements.

Student Financial Support: Graduate assistantships and fellowships will be awarded to qualified applicants depending on funding availability and program space. Tuition is typically waived for students granted assistantships. Student health insurance is also provided to all students on assistantship.

Other Relevant Information: A thesis (M.S. and Ph.D.) or special problem (Master of Crop Science) outline and Plan of Graduate Work should be submitted to the Director of Graduate Programs by the end of the first regular (spring or fall) semester.

GRADUATE COURSES

- CS(HS,PP) 502 Plant Disease: Methods and Diagnosis.
- CS 601 Seminar.
- CS 620 Special Problems.
- CS 685 Master's Supervised Teaching
- CS 690 Master's Examination.
- CS 693 Master's Supervised Research.
- CS 695 Master's Thesis Research.
- CS 696 Summer Thesis Research.
- CS 699 Master's Thesis Preparation.
- CS 711 Tobacco Technology.
- CS 713 Physiological Aspects of Crop Production.
- CS(HS) 715 Weed Science Research Techniques.
- CS(HS) 716 Weed Biology.
- CS(HS) 717 Weed Management Systems.
- CS(HS) 718 Biological Control of Weeds.
- CS(GN) 719 Origin and Evolution of Cultivated Plants.
- CS(GN,HS) 720 Molecular Biology in Plant Breeding.
- CS(HS,SSC,TOX) 725 Pesticide Chemistry.
- CS(HS,SSC,TOX) 727 Pesticide Behavior and Fate in the Environment.
- CS(HS) 729 Herbicide Behavior in Plants.
- CS(NG,HS) 741 Plant Breeding Methods.
- CS(GN,HS) 745 Quantitative Genetics in Plant Breeding.
- CS(GN,HS) 746 Breeding Methods.
- CS(GN,HS,PP) 748 Breeding for Pest Resistance

CS(FOR,SSC) 777 Conservation and Sustainable Development I.
 CS 801 Seminar.
 CS 820 Special Problems.
 CS(GN,HS) 860 Plant Breeding Laboratory.
 CS(GN,HS) 861 Plant Breeding Laboratory.
 CS 885 Doctoral Supervised Teaching.
 CS 890 Doctoral Preliminary Examination.
 CS 893 Doctoral Supervised Research.
 CS 895 Doctoral Dissertation Research.
 CS 896 Summer Dissertation Research.
 CS 899 Doctoral Dissertation Preparation.

Curriculum and Instruction

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Curriculum and Instruction	Y		Y			Y
Curriculum and Instruction, Elementary Education			Y			Y
Curriculum and Instruction, English Education			Y			Y
Curriculum and Instruction, Reading			Y			Y
Curriculum and Instruction, Social Studies Education			Y			Y
Instructional Technology - Computers			Y			Y
Middle Grades Education			Y			Y
Special Education			Y			Y
Special Education, Behavior Disorders			Y			Y
Special Education, Learning Disabilities			Y			Y
Special Education, Mental Retardation			Y			Y

GRADUATE FACULTY

T. P. O'Brien, *Head of the Department*

Director of Graduate Programs:

E. S. Vasu, Box 7801, 515.1779, ellen_vasu@ncsu.edu

Professors: C. L. Crossland, D. A. Cullinan, B. J. Fox, B. R. Poulton; **Adjunct Professors:** D. D. Copeland, R. A. Edelfelt; **Professors Emeriti:** B. M. Parramore; **Associate Professors:** P. L. Marshall, T. P. O'Brien, S. S. Osborne, C. A. Pope, R. J. Pritchard, E. J. Sabornie, H. A. Spires, E. S. Vasu; **Associate Professors Emeriti:** J. F. Arnold, M. B. Richards, L. Thies-Sprinthall;

Assistant Professors: M. L. Alibrandi, C. M. Beal, A. J. Reiman, A. V. Wilson; **Visiting Assistant Professors:** M. Terhaar-Yonkers; **Adjunct Assistant Professors:** S. B. Buckner

Admission Requirements: A 500-800 word statement describing professional goals. Some areas of study require that applicants be qualified to hold a baccalaureate-level teaching license or have teaching experience. GRE scores not more than five years old for the doctoral program. GRE or MAT scores not more than two years old for the master's program.

Master's Degree Requirements: A minimum of 36 course credit hours and a written examination are required. The Master of Science degree requires a final oral examination and thesis approved by the graduate committee.

Doctoral Degree Requirements: A minimum of 72 course credit hours which includes 15-18 hours of research and a curriculum specialty and 12 hours of dissertation credit.

Student Financial Support: No financial aid is available on a regular basis.

Other Relevant Information: The department offers master's degrees in curriculum and instruction, elementary education, English education, instructional technology, middle grades education, reading education, social studies education and special education with areas of concentration in business and marketing education, curriculum /supervision and language arts education. Master's degrees in special education are offered in the areas of behavior disorders, learning disabilities and mental retardation. A master's degree in middle grades education includes a dual concentration in language arts and social studies.

GRADUATE COURSES

- ECI 500 Theory and Practice in Teaching Diverse Populations.
- ECI 501 Foundations of Curriculum.
- ECI 502 Teaching through the Arts.
- ECI 503 Effective Teaching.
- ECI 504 Principles and Practices of Supervision.
- ECI 509 Special Problems in Curriculum and Instruction.
- ECI 510 Research Applications in Curriculum and Instruction.
- ECI 511 Computer Applications and Curriculum Integration in K-12 Instruction.
- ECI 514 Multimedia Design and Applications in K-12 Instruction.
- ECI 515 Internet Applications and Web Design in K-12 Settings.
- ECI 516 Design and Evaluation of Instructional Materials.
- ECI 517 Advanced Multimedia Design and Applications in K-12 Instruction.
- ECI 518 Program and Staff Development in Instructional Technology.
- ECI 519 Special Problems in Instructional Technology.
- ECI 520 The Teaching of Composition.
- ECI 521 Teaching Literature for Young Adults.
- ECI 524 Issues in Elementary School Teaching.
- ECI 525 Contemporary Approaches in the Teaching of Social Studies.
- ECI 526 Theory and Research on Teaching and Learning Social Studies.
- ECI 527 Special Problems in Social Studies.
- ECI 529 Special Problems in English Education.
- ECI 530 Social Studies in the Elementary School.
- ECI 532 Early Childhood Education.
- ECI 533 Language Arts in the Elementary School.
- ECI 539 Special Problems in Elementary School.
- ECI 540 Reading in the Elementary School.
- ECI 541 Reading in the Content Areas.
- ECI 542 Literacy Instruction for College Students: Research, Theory and Practice.

ECI 543 Diagnosis of Reading Disabilities.
ECI 544 Remediation of Reading Disabilities.
ECI 545 Literacy Theory and Research.
ECI 546 Literacy Instruction, Technology and Media.
ECI 547 Teaching Children's Literature.
ECI 549 Special Problems in Reading.
ECI 550 Foundations of Middle Years Education.
ECI 551 Teaching/Learning Approaches for Emerging Adolescents.
ECI 559 Special Problems in Middle Years Education.
ECI 560 Professional Development in Business and Marketing Education.
ECI 561 Curriculum and Instruction in Business and Marketing Education.
ECI 562 Business and Marketing Education Program Management.
ECI 569 Special Problems in Business and Marketing Education.
ECI 570 Learning Disabilities.
ECI 571 Methods and Materials in Learning Disabilities.
ECI 572 Resource Teaching in Special Education.
ECI 573 Classroom Management in Special Education.
ECI 574 Mental Retardation.
ECI 575 Communication Disorders in the Classroom.
ECI 576 Methods and Materials in Teaching Persons with Mental Retardation.
ECI 577 Education of Severely Handicapped.
ECI 578 Methods for Teaching the Gifted.
ECI 580 Transition Program for Students with Mild Disabilities.
ECI 581 Educational Diagnosis and Prescription for Children with Exceptionalities
ECI 582 Introduction to the Gifted Individual.
ECI 583 Behavior Disorders.
ECI 584 Methods and Materials: Behavior Disorders.
ECI 585 Education of Exceptional Children.
ECI 597 Special Problems in Special Education.
ECI 601 Seminar.
ECI 602 Seminar in Selected Topics in Curriculum and Instruction.
ECI 603 Advanced Seminar in Literacy.
ECI 604 Seminar in Conflict Resolution and Mediation in Schools.
ECI 606/806 Seminar on Teacher as Learner: Developmental Theory, Research and Practice.
ECI 607/807 Advanced Seminar in Multicultural Education.
ECI 620 Special Problems.
ECI 630 Independent Study in Curriculum and Instruction.
ECI 640 Practicum in Curriculum and Instruction.
ECI 641 Practicum in Mentoring of Teachers.
ECI 642 Practicum I - Instructional Technology.
ECI 643 Practicum in Social Studies.
ECI 644 Practicum in Elementary Education.
ECI 645 Diagnostic-prescriptive Practicum in Reading.
ECI 646 Practicum in Middle Grades Education.
ECI 647 Practicum in Marketing Education.
ECI 648 Practicum in Special Education.
ECI 649 Practicum II - Instructional Technology.
ECI 650 Internship in Curriculum and Instruction.
ECI 651 Internship in Mentoring.
ECI 652 Internship in Instructional Technology - Computers.
ECI 653 Internship in Social Studies.
ECI 654 Internship in Elementary Education.
ECI 655 Internship in Reading Education.
ECI 656 Internship in Middle Grades Education.
ECI 657 Internship in Business and Marketing Education.
ECI 658 Internship in Special Education.
ECI 680 Directed Research in Curriculum and Instruction.
ECI 685 Master's Supervised Teaching.
ECI 690 Master's Examination.
ECI 691 Research Applications in Curriculum and Instruction.
ECI 692 Master's Research Projects.
ECI 693 Master's Supervised Research.

ECI 695 Master's Thesis Research.
ECI 696 Summer Thesis Research.
ECI 699 Master's Thesis Preparation.
ECI 700 The School Curriculum.
ECI 701 Foundations of Curriculum.
ECI 704 Principles and Practices of Supervision.
ECI 705 Instructional Supervision of Teachers.
ECI 709 Special Problems in Curriculum and Instruction.
ECI 710 Research Applications in Curriculum and Instruction.
ECI 711 Computer Applications and Curriculum Integration in K-12 Instruction.
ECI 714 Multimedia Design and Applications in K-12 Instruction.
ECI 715 Internet Applications and Web Design in K-12 Settings.
ECI 716 Design and Evaluation of Instructional Materials.
ECI 717 Advanced Multimedia Design and Applications in K-12 Instruction.
ECI 718 Program and Staff Development in Instructional Technology.
ECI 719 Special Problems in Instructional Technology.
ECI 720 The Teaching of Composition.
ECI 721 Teaching Literature for Young Adults.
ECI 727 Special Problems in Social Studies Education.
ECI 729 Special Problems in English Education.
ECI 731 Teachers and the Elementary School Curriculum.
ECI 739 Special Problems in Elementary Education.
ECI 741 Reading in the Content Area.
ECI 745 Literacy Theory and Research.
ECI 746 Literacy Instruction, Technology and Media
ECI 747 Teaching Children's Literature.
ECI 749 Special Problems in Reading Education.
ECI 751 Teaching/Learning Approaches for Emerging Adolescents.
ECI 759 Special Problems in Middle Years Education.
ECI 769 Special Problems in Marketing Education.
ECI 786 Introduction to Issues and Techniques in Visual Impairments.
ECI 787 Orientation and Mobility of the Visually Impaired.
ECI 788 Structure and Function of the Eye and Use of Low Vision.
ECI 789 Teaching Braille and Communication Skills.
ECI 790 Methods and Materials in Visual Impairments.
ECI 797 Special Problems in Special Education.
ECI 801 Seminar.
ECI 802 Seminar in Curriculum and Instruction.
ECI 803 Advanced Seminar in Literacy.
ECI 804 Seminar on Attention Deficit Hyperactivity Disorder, Research and Treatment
ECI 806/606 Seminar on Teacher as Learner: Developmental Theory, Research and Practice.
ECI 807/607 Advanced Seminar in Multicultural Education.
ECI 820 Special Problems.
ECI 830 Independent Study in Curriculum and Instruction.
ECI 840 Practicum in Curriculum and Instruction.
ECI 841 Practicum in Mentoring of Teachers.
ECI 842 Practicum in Instructional Technology - Computers.
ECI 843 Practicum in Social Studies.
ECI 844 Practicum in Elementary Education.
ECI 845 Diagnostic-Prescriptive Practicum in Reading.
ECI 846 Practicum in Middle Grades Education.
ECI 847 Practicum in Marketing Education.
ECI 848 Practicum in Special Education.
ECI 850 Internship in Curriculum and Instruction.
ECI 851 Internship in Mentoring.
ECI 852 Internship in Instructional Technology.
ECI 853 Internship in Social Studies.
ECI 854 Internship in Elementary Education.
ECI 855 Internship in Reading Education.
ECI 856 Internship in Middle Grades Education.
ECI 857 Internship in Marketing Education.
ECI 858 Internship in Special Education

ECI 880 Directed Study in Curriculum and Instruction.
ECI 885 Doctoral Supervised Teaching.
ECI 890 Doctoral Preliminary Examination.
ECI 891 Research Applications in Curriculum and Instruction.
ECI 892 Doctoral Research Projects.
ECI 893 Doctoral Supervised Research.
ECI 895 Doctoral Dissertation Research.
ECI 896 Summer Dissertation Research.
ECI 899 Doctoral Dissertation Preparation.

Curriculum and Instruction, Elementary Education

For a listing of graduate faculty and program information, see curriculum and instruction.

Curriculum and Instruction, English Education

For a listing of graduate faculty and program information, see curriculum and instruction.

Curriculum and Instruction, Reading

For a listing of graduate faculty and program information, see curriculum and instruction.

Curriculum and Instruction, Social Studies Education

For a listing of graduate faculty and program information, see curriculum and instruction.

Design

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Design	Y					

GRADUATE FACULTY

Director of Graduate Programs:

J. W. Place, Box 7701, 515.8354, wayne_place@ncsu.edu

Professors: P. Batchelor, M. J. Davis, H. Khachatoorian, D. W. Martin, R. C. Moore, J. W. Place, M. Scotford; **Associate Professors:** B. W. Laffitte, S. R. Raval, D. G. Raymond, F. A. Rifki, J. O. Tector; **Research Associate Professors:** N. M. White; **Assistant Professors:** P. FitzGerald, R. A. St. Amant

The aim of the Ph.D. in design is to prepare students holding previous degrees in a design discipline to conduct collaborative research between architecture and landscape architecture and between graphic design and industrial design through two areas of concentration, either community and environmental design or information design. Graduates holding this degree will be valuable to college and university programs and to government, business and industrial organizations requiring the intellectual rigor, knowledge and investigative skills developed by doctoral study. Students will conduct research aimed at improving the quality of design in urban and rural communities, improving people's understanding and interpretation of their social and ecological environment, and improving visual communication and product development technology aimed at meeting human needs.

Admission Requirements: The community and environmental design concentration requires a master's degree in architecture or landscape architecture while the information design concentration requires a master's degree with an undergraduate degree in graphic or industrial design. In addition to Graduate School requirements the submission of a portfolio demonstrating a capacity for doctoral research and an interest statement indicating a leaning toward teaching, research or consulting in the public or private sector are required. Prior to acceptance, a faculty member must agree to mentor an applicant.

Doctoral Degree Requirements: The program of study requires a minimum of 54 credit hours of graduate work beyond the master's degree, and of these credit hours, 18 will be independent research and dissertation credit with the remaining 36 hours of course work being completed in the Ph.D. program

Student Financial Support: Teaching and research assistantships are available to several doctoral students, and in addition, those students receiving some form of assistantship will also receive tuition remission. Assistantships are awarded on the recommendation of the admissions' committee.

GRADUATE COURSES

- DDN 771/GD 571 Design as Cognitive Artifact.
- DDN 772/GD 572 Design as Cultural Artifact.
- DDN 773/GD 573 New Information Environments.
- DDN 776/ARC 576/LAR 576 Community Design.
- DDN 777/ARC 577/LAR 577 Sustainable Communities.
- DDN 778/LAR 578 Ecological Design.
- DDN 779/LAR 579 Human Use of the Urban Landscape.
- DDN 809 Dissertation Colloquium.
- DDN 830, 831 Information Design.
- DDN 885 Doctoral Supervised Teaching.
- DDN 890 Doctoral Preliminary Examination.
- DDN 893 Doctoral Supervised Research.
- DDN 895 Doctoral Dissertation Research.
- DDN 896 Summer Dissertation Research.
- DDN 899 Doctoral Dissertation Preparation.

Economics

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Agricultural and Resource Economics			Y			
Economics	Y			Y	Y	

GRADUATE FACULTY

Director of Graduate Programs:

J. E. Easley Jr., Box 8110, 515.4617, jim_easley@ncsu.edu

Hugh C. Kiger Professor: A. B. Brown

University Distinguished Professor: V. K. Smith

William Neal Reynolds Professor: M. K. Wohlgemant

Professors: S. G. Allen, J. A. Brandt, G. A. Carlson, R. L. Clark, L. A. Craig, L. E. Danielson, J. E. Easley Jr., E. W. Erickson, E. A. Estes, D. Fisher, D. J. Flath, B. K. Goodwin, T. J. Grennes, A. R. Hall, M. T. Holt, D. M. Holthausen Jr., D. N. Hyman, T. Johnson, C. R. Knoeber, J. S. Lapp, S. E. Margolis, M. C. Marra, C. L. Moore Sr., R. B. Palmquist, D. K. Pearce, C. D. Safley, R. A. Schrimper, J. J. Seater, W. N. Thurman, M. L. Walden; **Associate Professors:** D. S. Ball, G. A. Benson, P. L. Fackler, A. E. Headen Jr., M. B. McElroy, C. M. Newmark, A. W. Oltmans, M. A. Renkow, T. C. Tsoulouhas, T. Vukina, W. J. Wessels, K. D. Zering; **Assistant Professors:** D. G. Hallstrom, A. Inoue, R. L. Lamb, A. P. Levy, D. J. Phaneuf, N. E. Piggott, S. E. Scullen

ASSOCIATE MEMBERS OF THE PROGRAM

Professors: R. H. Bernhard, D. A. Dickey; **Associate Professors:** J. C. Dutton, Jr., E. A. McDermid

The economics graduate program is a joint program of the Department of Agricultural and Resource Economics and the Department of Economics. Emphasis is placed on economic theory and quantitative economic analysis and their application to economic problems. The major fields of specialization are: agricultural economics, econometrics, environmental/resource economics, industrial organization, international economics, labor economics and macro-monetary economics.

Admission Requirements: Minimum background for admission includes intermediate microeconomics and macroeconomics, at least one semester of calculus (two for Ph.D.) and undergraduate statistics. Some students are admitted conditional on their taking certain prerequisites. The submission of GRE scores is strongly recommended and is required for students applying for financial aid.

Master's Degree Requirements: The Master of Science in agricultural and resource economics and the Master of Arts in economics require core courses in micro-economics (ECG 505 or ECG

700), macroeconomics (ECG 506 or ECG 703), statistics (ST 504) and applied econometrics (ECG 561). Both degree have thesis and elective requirements. The Master of Economics is a non-thesis degree with two options: (1) Ph.D. Preparatory and (2) Applied Economics and Policy Analysis. Both options require a core of ECG 700 (or ECG 505), ECG 703 (or ECG 506), ST 514 and ECG 561. In addition ECG 765 is highly recommended for Option 1 while Option 2 also requires ECG 562. Both options have elective requirements.

Doctoral Degree Requirements: The Ph.D. program requires a minimum of 72 hours and at least six semesters of work beyond the bachelor's degree. Students must pass written comprehensive examinations in micro-economics and macro-economics. Course requirements include two semesters of econometrics and six field courses.

Student Financial Support: Research and teaching assistantships are available and are awarded on a competitive basis. Most of these assistantships go to Ph.D. students. Students applying for assistantships are advised to apply by February 15 for fall admission.

Other Relevant Information: Graduate students on financial support are provided office space or study carrels. Other students may be assigned study carrels if available. All students have access to the economics graduate student computer lab.

GRADUATE COURSES

ECG(PRT) 503 Economics of Recreation.
ECG 504 Monetary and Financial Macroeconomics.
ECG 505 Applied Microeconomic Analysis.
ECG 506 Applied Macroeconomic Analysis.
ECG 507 Economics for Managers..
ECG 508 Macroeconomics and the Business Environment.
ECG 512 Law and Economics.
ECG 514 Economics of Information Goods.
ECG 515 Environmental and Resource Policy.
ECG 521 Markets and Trade.
ECG 523 Planning Farm and Area Adjustments.
ECG 532 Economics of Trade Unions.
ECG 533 Economics of World Food and Agricultural Policy.
ECG 537 Health Economics.
ECG 540 Economic Development.
ECG 551 Agricultural Production Economics.
ECG 555 Managerial Economics.
ECG(ST) 561 Intermediate Econometrics.
ECG 562 Topics in Applied Econometrics.
ECG 570 Analysis of American Economic History.
ECG 590 Special Topics.
ECG 630 Independent Study.
ECG 690 Master's Examination.
ECG 695 Master's Thesis Research.
ECG 696 Summer Thesis Research.
ECG 699 Master's Thesis Preparation.
ECG 700 Price Theory.
ECG 701 Advanced Price Theory.
ECG 702 Prices, Value and Welfare.
ECG 703 Income and Employment Theory.
ECG 704 Advanced Income and Employment Theory.
ECG 705 Monetary Economics.
ECG 706 Industrial Organization and Control.
ECG 707 Topics in Industrial Organization.

ECG 708 History of Economic Thought.
ECG 710 Theory of Public Finance.
ECG 715 Environmental and Resource Economics.
ECG 716 Topics in Environmental and Resource Economics.
ECG 730 Labor Economics.
ECG 731 Policy and Research Issues in Labor Economics.
ECG 739 Economic Growth and Development I.
ECG 740 Economic Growth and Development II.
ECG 741 Agricultural Production and Supply.
ECG 742 Consumption, Demand and Market Interdependency.
ECG 748 Theory of International Trade.
ECG 749 Monetary Aspects of International Trade.
ECG 750 Economic Decision Theory.
ECG(ST) 751 Econometrics.
ECG(ST) 752 Topics in Econometrics.
ECG 765 Mathematical Methods for Economics.
ECG 784 Advanced Macroeconomics.
ECG 785 Monetary Theory.
ECG 790 Advanced Special Topics.
ECG 830 Independent Study.
ECG 895 Doctoral Dissertation Research.
ECG 896 Summer Dissertation Research.
ECG 899 Doctoral Dissertation Preparation.

Educational Administration and Supervision

For a listing of graduate faculty and program information, see educational research leadership and counselor education.

Educational Research and Policy Analysis

For a listing of graduate faculty and program information, see educational research leadership and counselor education.

Educational Research, Leadership and Counselor Education

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Agency Counseling			Y			Y
Counselor Education	Y		Y			Y
Educational Administration and Supervision		Y				
Educational Research and Policy Analysis	Y					
School Administration					Y	

GRADUATE FACULTY

S. B. Baker, *Head of the Department*

Director of Graduate Programs:

E. R. Gerler Jr., Box 7801, 515.5975, edwin_gerler@ncsu.edu

R. C. Serow, Box 7801, 515.1766, robert_serow@ncsu.edu

Professors: J. A. Anderson, S. B. Baker, E. R. Gerler Jr., L. K. Jones, T. L. Robinson, R. C. Serow, R. G. Taylor Jr.; **Professors Emeriti:** B. G. Beezer, C. J. Dolce, E. MacPhail-Wilcox, N. A. Sprinthall; **Associate Professors:** P. F. Bitting, H. A. Exum, W. J. Johnston; **Associate Professors Emeriti:** J. G. McVay; **Assistant Professors:** K. H. Brinson Jr., R. A. Rolle, S. Ting; **Visiting Assistant Professors:** E. Freeman, R. L. Haley, P. A. Hessling; **Adjunct Assistant Professors:** W. C. Harrison

ASSOCIATE MEMBERS OF THE PROGRAM

Professors: C. K. Coe, D. M. Daley, D. C. Locke, J. H. Svara; **Associate Professors:** E. O'Sullivan, J. E. Swiss

Admission Requirements: Requirements include a 3.00 average (4.00 scale) in the junior and senior years of the undergraduate program and one year of work experience in a human services capacity. The best-qualified applicants will be accepted up to the number of spaces that are available for new students. Exceptions to the minimum grade-point average and work experience requirements may be made for students with special backgrounds, abilities and interests.

Admission requirements for the Ph.D. program include, in addition to the general admission requirements, a 48-semester-hour master's degree, the completion of a work sample and a personal interview.

Master's Degree Requirements: A minimum of 48 semester hours are required in all master's degree tracks.

Doctoral Degree Requirements: Approximately 66 semester hours of required course work in the Ph.D. program in counselor education includes courses in research, behavioral sciences foundation, counselor education theory and professional application.

Other Relevant Information: The Council for Accreditation of Counseling and Related Educational Programs (CACREP), a specialized accrediting body recognized by the Council on Post-secondary Accreditation (COPA), has conferred accreditation to the following program areas in the Department of Educational Research, Leadership and Counselor Education: student development in higher education (M.S., M.Ed.) and the Ph.D. program in counselor education. These program area have admission and curriculum requirements that conform to CACREP standards. The school counseling and community/agency tracks (M.S., M.Ed.) are CACREP-like in preparation for being accredited by CACREP.

GRADUATE COURSES

ECD 510 Introduction to Counseling.

ECD 524 Career Counseling and Development.

ECD 525 Cross Cultural Counseling.

ECD 530 Theories and Techniques of Counseling

ECD 533 Guidance and Counseling in the Secondary Schools

ECD 534 Guidance and Counseling in Elementary and Middle Schools

ECD 535 Student Development in Higher Education.
ECD 536 Community Service Agencies
ECD 539 Group Counseling
ECD(WGS) 540 Gender Issues in Counseling.
ECD 543 The American College Student.
ECD 561 Research and Assessment in Counseling.
ECD 590 Special Problems.
ECD 620 Special Problems in Guidance.
ECD 640 Prepracticum in Counseling.
ECD 641 Introductory Practicum in Counseling.
ECD 642 Practicum in Counseling.
ECD 651 Internship in School Counseling.
ECD 652 Internship in College Student Development.
ECD 653 Internship in Agency Counseling.
ECD 666 Observation and Supervised Field Work.
ECD 692 Master's Research Project.
ECD 693 Master's Supervised Research.
ECD 695 Master's Thesis Research.
ECD 696 Summer Thesis Research.
ECD 699 Master's Thesis Preparation.
ECD 731 Career Development Theory and Research.
ECD 733 Cognitive-behavioral Theory, Research and Practice.
ECD 735 Counseling Supervision: Theory and Research.
ECD 737 Cognitive-developmental Theory, Research and Practice.
ECD 738 Research in Counselor Education.
ECD 740 Advanced Psycho-social Identity Development: Race, Gender and Culture.
ECD 790 Special Problems.
ECD 820 Special Problems.
ECD 843 Advanced Counseling Practicum.
ECD 847 Counseling Supervision: Practicum.
ECD 850 Internship in Counselor Education.
ECD 860 Professional Issues in Counseling.
ECD 885 Doctoral Supervised Teaching.
ECD 886 Supervised Practice Teaching in Counselor Education.
ECD 890 Doctoral Preliminary Examination.
ECD 892 Doctoral Research Project.
ECD 893 Doctoral Supervised Research.
ECD 895 Doctoral Dissertation Research.
ECD 896 Summer Dissertation Research.
ECD 899 Doctoral Dissertation Preparation.

Electrical and Computer Engineering

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Computer Engineering	Y		Y			
Electrical Engineering	Y		Y			

GRADUATE FACULTY

J. J. Grainger, *Head of the Department*

Director of Graduate Programs:

R. T. Kuehn, Box 7911, 515.5090, rkuehn@eos.ncsu.edu

Distinguished Professor: N. A. Masnari

Distinguished University Professor: B. J. Baliga

Distinguished University Research Professor: D. L. Bitzer

Graduate Alumni Distinguished Professor: S. M. Bedair, J. B. O'Neal, Jr.

Professors: W. E. Alexander, G. L. Bilbro, P. D. Franzon, T. H. Glisson Jr., J. J. Grainger, J. R. Hauser, J. F. Kauffman, K. W. Kim, R. M. Kolbas, M. A. Littlejohn, W. Liu, T. K. Miller III, H. T. Nagle Jr., A. A. J. Nilsson, C. M. Osburn, M. C. Ozturk, S. A. Rajala, W. E. Snyder, M. B. Steer, J. K. Townsend, H. J. Trussell, J. J. Wortman; **Visiting Professors:** F. Brglez, W. C. Holton, J. W. Mink; **Adjunct Professors:** R. K. Cavin III, M. Dutta, R. Luo; **Professors Emeriti:** L. K. Monteith, A. Reisman, D. R. Rhodes, M. A. Stroscio; **Associate Professors:** S. T. Alexander, M. Chow, T. M. Conte, E. F. Gehringer, E. Grant, B. L. Hughes, A. W. Kelley, A. Mortazawi, D. S. Reeves, I. Viniotis, M. W. White; **Visiting Associate Professors:** J. J. Brickley, T. L. Mitchell; **Adjunct Associate Professors:** J. R. Burke, R. S. Gyurecsik, S. S. Lee, D. Temple; **Associate Professors Emeriti:** G. F. Bland, W. C. Peterson; **Assistant Professors:** M. E. Baran, G. T. Byrd, A. G. Dean, A. Duel-Hallen, A. E. Eichenberger, C. S. Gloster Jr., H. Krim, G. Lazzi, V. Misra, E. Rotenberg, Z. Zhang; **Visiting Assistant Professors:** W. D. Allen, R. T. Kuehn, J. F. Muth, D. G. Yu; **Adjunct Assistant Professors:** L. J. Bottomley, J. M. Conrad, D. L. Dreifus, A. Montalvo, A. S. Morris III, A. J. Rindos III, P. I. Santiago, J. C. Sutton III, E. M. Vogel, K. V. Vu, C. K. Williams, M. S. Yousif; **Interinstitutional Faculty:** J. H. Kim, R. Z. Makki

ASSOCIATE MEMBERS OF THE PROGRAM

Professors: J. Narayan, E. W. Davis, Jr., S. Khorram, D. F. McAllister, H. G. Perros, J. F. Schetzina, K. Tai, M. A. V. Vouk; **Associate Professors:** M. F. M. Stallmann

Admissions Requirements: Admission to the M.S. program requires a B.S. in electrical engineering, computer engineering or computer science, an overall undergraduate GPA of at least 3.5. The minimum acceptable TOEFL score for admission to the M.S. program is 575. Admission is further limited by available room in the elected program of study and meeting the minimum above requirements alone does not guarantee admission.

Admission to the Ph.D. program requires a B.S. or M.S. in electrical engineering, computer engineering or computer science with an overall GPA of at least 3.5. (NOTE: Only exceptional students are admitted without first having an M.S. degree.) The minimum acceptable TOEFL score for admission to the Ph.D. program is 625. Admission is further limited by available room in the elected program of study, and meeting the minimum requirements as given above does not guarantee admission.

Master's Degree Requirements: A thesis is optional. Students electing the Option B non-thesis option must meet core course requirements and have at least six credit hours of 600-level ECE courses.

Doctoral Degree Requirements: Approximately 42 credit hours are required beyond the M.S. degree or 72 credit hours beyond the B.S. degree. A minimum of 21 of the 42 credit hours or a minimum of 45 of the 72 credit hours must be in scheduled courses. A minor is not required but

may be elected. Additional course restrictions apply if a minor is not elected.

The department wishes to evaluate a Ph.D. student's research potential as quickly as possible. Consequently, all Ph.D. students are required to pass a qualifying review before the end of their third semester of study. This review is based on the student's academic performance to date and the results of a project with one of their committee members. Results are presented to the committee in both written and oral form. Based on this review, the committee will decide if the student may continue in the Ph.D. program.

Student Financial Support: The department offers financial support to qualified students in the form of teaching assistantships, research assistantships, fellowships and tuition remission.

GRADUATE COURSES

- ECE(CSC) 506 Architecture of Parallel Computers.
- ECE(CSC) 510 Software Engineering.
- ECE(CSC) 517 Object-oriented Languages and Systems.
- ECE 520 Digital ASIC Design.
- ECE 521 Computer Design and Technology.
- ECE 549 RF Design for Wireless.
- ECE(PY) 552 Introduction to the Structure of Solids.
- ECE(CSC) 570 Computer Networks.
- ECE(CSC) 572 Introduction to Computer Communications.
- ECE(CSC) 573 Internetwork Protocols and Architectures.
- ECE(CSC) 576 Telecommunications Systems Engineering.
- ECE(CSC,OR) 579 Introduction to Computer Performance Modeling.
- ECE 591 Special Topics in Electrical Engineering
- ECE 592 Special Topics in Electrical and Computer Engineering.
- ECE 633 Individual Topics in Electrical Engineering.
- ECE 634 Individual Studies in Electrical Engineering.
- ECE 685 Master's Supervised Teaching.
- ECE 693 Master's Supervised Research.
- ECE 695 Master's Thesis Research.
- ECE 699 Master's Thesis Preparation.
- ECE 703 Instrumentation Circuits.
- ECE 704 Logic Design for Testability.
- ECE 711 Analog Electronics.
- ECE 712 Analog VLSI.
- ECE 713 Digital Signal Processing.
- ECE 714 Random Processes.
- ECE 715 Digital Communications.
- ECE 716 System Control Engineering.
- ECE (MAE,TE) 717 Multivariate Linear Systems Theory.
- ECE 718 Computer-aided Circuit Analysis.
- ECE 719 Microwave Circuits Design.
- ECE 722 Electronic Properties of Solid-state Materials.
- ECE 723 Optical Properties of Semiconductors.
- ECE 724 Electronic Properties of Solid-state Devices.
- ECE 725 Optical Signal Processing.
- ECE 726 Advanced Feedback Control.
- ECE(PY) 727 Semiconductor Thin Films Technology.
- ECE 728 Preparation of Electronic Materials.
- ECE 729 Growth of Thin Films from the Vapor Phase.
- ECE 730 Physical Electronics.
- ECE 731 Principles of Transistor Devices.
- ECE 732 Principles of Microwave Circuits.
- ECE 733 Digital Electronics.
- ECE 734 Switchmode DC-to-DC Converters.

ECE 735 Advanced Solid-state Device Theory.
ECE 736 Power System Stability and Control.
ECE 737 Characterization of High-speed Devices.
ECE 738 Integrated Circuits Technology and Fabrication.
ECE 739 Integrated Circuits Technology and Fabrication Laboratory.
ECE 740 Electromagnetic Fields.
ECE 741 Sequential Machines.
ECE 742 Artificial Neural Networks.
ECE 743 High Performance Multicomputer Architecture.
ECE 744 Design of Electronic Packaging and Interconnects.
ECE 746 VLSI Systems Design.
ECE 747 Digital Signal Processing Architecture.
ECE(CSC) 748 Parallel Processing.
ECE 749 RF Design for Wireless.
ECE 750 Power System Operation and Control.
ECE 751 Detection and Estimation Theory.
ECE 753 Computer Analysis of Large-scale Power Systems.
ECE 755 Fault Tolerant Computing.
ECE 756 High Performance VLSI Design.
ECE 757 Principles of MOS Transistors.
ECE 758 Digital Image Systems.
ECE 759 Pattern Recognition.
ECE 760 Multidimensional Digital Signal Processing.
ECE 761 Design Automation for VLSI.
ECE 762 Advanced Digital Communications Systems.
ECE 763 Computer Vision.
ECE 764 Digital Image Processing.
ECE(CSC) 776 Performance Evaluation of Computer Networks.
ECE(CSC) 777 Telecommunications Network Design.
ECE 778 Optical Fiber Communications.
ECE(CSC) 779 Advanced Computer Performance Modeling.
ECE 781, 782 Special Studies in Electrical Engineering.
ECE 791 Special Topics in Electrical Engineering.
ECE 792 Special Topics in Electrical Engineering.
ECE 801 Seminar in Electrical and Computer Engineering.
ECE 802 Seminar in Circuits and Systems.
ECE 803 Seminar in Computer Engineering.
ECE 804 Seminar in Communications and Signal Processing.
ECE 805 Seminar in Solid State.
ECE 833 Individual Topics in Electrical and Computer Engineering.
ECE 834 Individual Studies in Electrical and Computer Engineering.
ECE 885 Doctoral Supervised Teaching.
ECE 890 Doctoral Preliminary Examination.
ECE 893 Doctoral Supervised Research.
ECE 895 Doctoral Dissertation Research.
ECE 899 Doctoral Dissertation Preparation.

Electrical Engineering

For a listing of graduate faculty and program information, see electrical and computer engineering.

Engineering - (Off-campus program only)

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Engineering (Off-campus, continental US residents and/or employees only)					Y	

GRADUATE FACULTY

Director of Graduate Programs:

M. M. Fikry, Box 7547, 515.5440, jim_fikry@ncsu.edu

The College of Engineering offers a program leading to the Master of Engineering. This is primarily an off-campus program. This Option B program requires 30 credit hours and has no residency, final oral examination or thesis requirements. Requirements also include two core courses and a minimum of three courses in a specific concentration. A minimum of five courses, selected from a list specified and approved by the designating department, is required for a designated concentration on the transcript. The Video Based Engineering Education (VBEE) program offers, each semester, courses, live or by videotape, which may be applied toward the degree.

Admission Requirements: The program does not accept international students who reside outside the continental U.S.

English

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
English				Y		
Technical Communication			Y			

GRADUATE FACULTY

T. D. Lisk, *Head of the Department*

Director of Graduate Programs:

R. V. Young Jr., Box 8105, 515.4107, ryoung@social.chass.ncsu.edu

Graduate Alumni Distinguished Professor: C. R. Miller

William C. Friday Distinguished Professor: W. A. Wolfram

Professors: C. M. Anson, B. J. Baines, J. Balaban, J. W. Clark Jr., J. Ferster, J. A. Gomez, J. M. Grimwood, A. H. Harrison, M. T. Hester, L. T. Holley, J. J. Kessel, T. D. Lisk, L. H. MacKethan, W. E. Meyers, J. O. Pettis, C. A. Prioli, J. J. Small, A. F. Stein, J. N. Wall Jr., R. V. Young Jr.; **Professors Emeriti:** G. W. Barrax, P. E. Blank Jr., L. S. Champion, J. D. Durant, M. Halperen, H. G. Kincheloe, A. S. Knowles, B. G. Koonce Jr., F. H. Moore, L. Smith, J. J. Smoot, W. B. Toole III, M. C. Williams, P. J. Williams; **Associate Professors:** M. P. Carter, D. H. Covington, A. Davis-Gardner, C. Gross, D. J. Herman, S. B. Katz, M. F. King, R. C. Kochersberger Jr., D. L. Laryea, J. E. Morrison, C. Nwankwo, M. E. N. Orr, A. M. Penrose, S. M. Setzer, L. R. Severin, J. F. Thompson, H. C. West, D. B. Wyrick; **Associate Professors Emeriti:** L. J. Betts Jr., E. P. Dandridge Jr., H. A. Hargrave, C. E. Moore, N. G. Smith; **Assistant Professors:** C. J. Cobb, R. S. Dicks, M. B. Douglas, C. R. Haller, N. Halpern, S. M. Katz, P. W. LaCoste, L. S. May, B. S. Mehlenbacher, J. D. Morillo, M. T. Pramaggiore, K. Shepherd-Barr, E. R. Thomas, C. A. Warren, T. L. Weldon; **Visiting Assistant Professors:** W. M. Henderson, T. R. McLaurin

The Master of Arts program offers course work in English and American literature, rhetoric and composition, linguistics and creative writing. It can serve either as a complete course of study or as the first year of study toward a doctoral degree at another institution.

Admission Requirements: Applicants should submit GRE scores (General Aptitude Test) and a writing sample.

Requirements for M.A. in English: All students take a distribution of four courses, one each in English literature before 1660, English literature after 1660, American literature and a fourth category including composition theory, rhetoric, linguistics and literary theory. In addition, all students must take an introduction to research and bibliography, pass a language requirement, write a thesis and pass an oral exam on the thesis research.

Beyond these basic requirements, the program comprises four concentrations in literature, creative writing, composition and rhetoric, and linguistics. Each concentration requires five additional courses, of which three must pertain to the area of concentration. The thesis likewise will be written in the area of the concentration and directed by a specialist in the field. In creative writing this usually means a novel or a collection of short stories or poems.

Student Financial Support: Teaching assistantships are available for promising students. Teaching Assistants must arrive early for a week-long workshop before their first semester to be trained as graders and discussion leaders for undergraduate literature courses during their first year. During this first year they must also take ENG 511 (Theory and Research in Composition) and attend a second workshop before classes begin for their second year in order to teach freshman composition. These duties receive credit as English 685 (Master's Directed Teaching), but do not fulfill requirements for the degree.

Other Relevant Information: For students who hold initial licensure from the N. C. Department of Public Instruction, the department offers the M.A. with advanced licensure requiring 24 semester hours of graduate credit in English and 15 semester hours of graduate credit in Education. Students and faculty in the Department of English are eligible for fellowships to participate in programs sponsored by the Folger Institute of Renaissance and Eighteenth-Century Studies, which is located in Washington, DC, at the Folger Shakespeare Library.

TECHNICAL COMMUNICATION

The Master of Science in technical communication is designed to prepare professional communicators for advanced positions in industry and research organizations; with appropriate electives, students can prepare for careers in software documentation, environmental communication, medical writing, industrial training in writing and editing, publications management and related areas.

Admission Requirements: Applicants should submit a resume and a writing sample. Prerequisites for the program are basic editing, technical writing and computer literacy (ENG 214, ENG 331, and CSC 200).

Requirements for M.S. in Technical Communication: The program requires 33 semester hours: 15 hours in the fields of technical writing, publication management, rhetoric and a projects course; the remaining hours are taken in applications, theory and methods and cross-disciplinary courses. Students must also satisfy a requirement for one semester of professional work experience.

Student Financial Support: Teaching assistantships are available for promising students. These students take a course in teaching technical communication (ENG 666) in the fall semester and, under the supervision of experienced teachers, devote half time in subsequent semesters to teaching technical communication. ENG 666 gives graduate credit but does not count toward fulfillment of degree requirements.

GRADUATE COURSES

- ENG 508 Usability Studies for Technical Communication.
- ENG 509 Old English Literature.
- ENG 510 Middle English Literature.
- ENG 511 Theory and Research in Composition.
- ENG 512 Theory and Research in Professional Writing.
- ENG 513 Empirical Research in Composition.
- ENG(COM) 514 History of Rhetoric.
- ENG 515 Rhetoric of Science and Technology.
- ENG(COM) 516 Rhetorical Criticism: Theory and Practice.
- ENG 517 Advanced Technical Writing, Editing and Document Design.
- ENG 518 Publication Management for Technical Communicators.
- ENG 519 Online Information Design and Evaluation.
- ENG 520 Science Writing for the Media.
- ENG 521 Modern English Usage.
- ENG 522 Linguistics and Literacy.
- ENG 523 Language Variation Research Seminar.
- ENG 524 Introduction to Linguistics.
- ENG 525 Variety in Language.
- ENG 526 History of the English Language.
- ENG 527 Critical Discourse Analysis.
- ENG 528 Language Change Research Seminar.
- ENG 529 16th-century Non-dramatic English Literature.
- ENG 530 17th-century English Literature.
- ENG 531 American Colonial Literature.
- ENG(FL) 539 Seminar in World Literature.
- ENG 540 History of Literary Criticism.
- ENG 541 Contemporary Literary Theory.
- ENG 548 African-American Literature.
- ENG 549 Modern African Literature.
- ENG 550 English Romantic Period.
- ENG 551 Chaucer.

ENG 555 American Romantic Period.
ENG 558 Studies in Shakespeare.
ENG 560 Victorian Poetry and Critical Prose.
ENG 561 Milton.
ENG 562 18th-century English Literature.
ENG 563 18th-century English Novel.
ENG 564 Victorian Novel.
ENG 565 American Realism and Naturalism.
ENG 570 20th-century British Prose.
ENG 571 20th-century British Poetry.
ENG 572 Modern British Drama.
ENG 573 Modern American Drama.
ENG 574 Comparative Drama.
ENG 575 Southern Writers.
ENG 576 20th-century American Poetry.
ENG 577 20th-century American Prose.
ENG 578 English Drama to 1642.
ENG 579 Restoration and 18th-century Drama.
ENG 580 Literary Postmodernism.
ENG 582 Studies in Literature.
ENG 583 Studies in Composition and Rhetoric.
ENG 584 Studies in Linguistics.
ENG 585 Studies in Film.
ENG 586 Studies in Theory.
ENG 587 Film and Visual Theory.
ENG 588 Fiction Writing Workshop.
ENG 589 Poetry Writing Workshop.
ENG 590 Studies in Creative Writing.
ENG 591 Studies in National Cinemas.
ENG 624 Problems in College Composition.
ENG 636 Directed Readings.
ENG 666 Teaching Methods for Professional Writing.
ENG 669 Bibliography and Methodology.
ENG 675 Projects in Technical Communication.
ENG 685 Master's Supervised Teaching.
ENG 693 Master's Supervised Research.
ENG 695 Master's Thesis Research.
ENG 696 Summer Thesis Research.
ENG 699 Master's Thesis Preparation.

Entomology

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Entomology	Y		Y		Y	

GRADUATE FACULTY

J. D. Harper, *Head of the Department*

Director of Graduate Programs:

W. M. Brooks, Box 7613, 515.3771, wayne_brooks@ncsu.edu

Blanton J. Whitmire Distinguished Professor: C. Schal

Charles G. Wright Professor: J. Silverman

Philip Morris Professor: J. W. Van Duyn

William Neal Reynolds Professor: F. L. Gould, G. G. Kennedy

Professors: J. T. Ambrose, C. S. Apperson, J. S. Bacheler, J. R. Baker, J. R. Bradley Jr., R. L. Brandenburg, W. M. Brooks, L. L. Deitz, F. P. Hain, J. D. Harper, R. J. Kuhr, J. R. Meyer, B. M. Parker, R. M. Roe, K. A. Sorensen, P. S. Southern, R. E. Stinner, J. F. Walgenbach; **Adjunct Professors:**

D. M. Jackson, P. M. Marsh, D. E. Sonenshine; **Professors Emeriti:** R. C. Axtell, W. V. Campbell, M. H. Farrier, K. L. Knight, H. B. Moore Jr., H. H. Neunzig, R. L. Rabb, R. L. Robertson, C. G. Wright; **Associate Professors:** M. E. Barbercheck; **Adjunct Associate Professors:**

C. A. Nalepa; **Associate Professors Emeriti:** R. C. Hillmann; **Assistant Professors:** D.

B. Orr, C. E. Sorenson, E. L. Vargo, D. W. Watson, B. M. Wiegmann; **Visiting Assistant Professors:**

D. W. Keever, M. G. Waldvogel; **Adjunct Assistant Professors:** D. A. Herbert Jr., M. D. Tomalski

ASSOCIATE MEMBERS OF THE PROGRAM

Professors: R. B. Leidy, H. M. Linker; **Assistant Professors:** W. G. Buhler, D. J. Robison;

Visiting Assistant Professors: R. L. Rose

Course offerings or research facilities are available in the following areas: agricultural entomology, apiculture, behavior, biological control, ecology, forest entomology, host-plant resistance, insect pathology, medical and veterinary entomology, pest management, physiology, molecular biology, population dynamics, soil entomology, urban entomology, systems analysis, systematics and toxicology.

Admission Requirements: A minimum score of 1000 (verbal plus quantitative) is necessary for admission to the M.E. or M.S. program while a score of 1100 is required for the Ph.D. program. Students are expected to have a background in biology in addition to appropriate courses in chemistry, biochemistry, mathematics and physics. A "B" average (3.0 GPA) is required in biology courses and an overall 3.0 GPA during the last two years of the undergraduate program.

Student Financial Support: Graduate assistantships and other forms of aid are available to students as described in the Fellowships and Graduate Assistantships section of the Graduate Catalog.

Other Relevant Information: Admission is permitted only after acceptable applicants have secured an advisor and appropriate financial support. All students are expected to begin their research as soon as possible upon arrival in the department.

GRADUATE COURSES

ENT 501 Advanced Beekeeping.

ENT 502 Insect Systematics.

ENT 503 Insect Morphology and Physiology.

ENT(ZO) 509 Ecology of Stream Invertebrates.
ENT 525 Entomology for Educators.
ENT 550 Fundamentals of Insect Control.
ENT(ZO) 582 Medical and Veterinary Entomology.
ENT 601 Seminar.
ENT 604/804 Insect Natural History and Field Ecology.
ENT 620 Special Problems.
ENT 641 Practicum.
ENT 685 Master's Supervised Teaching.
ENT 690 Master's Examination.
ENT 693 Master's Supervised Research.
ENT 695 Master's Thesis Research.
ENT 696 Summer Thesis Research.
ENT 699 Master's Thesis Preparation.
ENT 720 Insect Pathology.
ENT(TOX) 722 Insecticide Toxicology.
ENT 731 Insect Ecology.
ENT 741 Immature Insects.
ENT 762 Insect Pest Management in Agricultural Crops.
ENT(FOR) 765 Advanced Forest Entomology.
ENT 791 Special Topics in Entomology.
ENT 801 Seminar.
ENT 804/604 Insect Natural History and Field Ecology.
ENT 820 Special Problems.
ENT 841 Practicum.
ENT 885 Doctoral Supervised Teaching.
ENT 890 Doctoral Preliminary Examination.
ENT 893 Doctoral Supervised Research.
ENT 895 Doctoral Dissertation Research.
ENT 896 Summer Dissertation Research.
ENT 899 Doctoral Dissertation Preparation.

Extension Education

For a listing of graduate faculty and program information, see agricultural and extension education.

Fiber and Polymer Science

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Fiber and Polymer Science	Y					

GRADUATE FACULTY

Director of Graduate Programs:

W. Oxenham, Box 8301, 515.6573, william_oxenham@ncsu.edu

Burlington Industries Professor of Textile Technology: R. L. Barker

Camille Dreyfus Professor: H. B. Hopfenberg

Ciba-Geigy Professor: H. S. Freeman

Hoechst Trevira Professor of Polymer Chemistry: A. E. Tonelli

Professors: S. K. Batra, K. R. Beck, D. R. Buchanan, C. L. Bumgardner, T. G. Clapp, A. H. M. El-Shiekh, R. E. Fornes, P. L. Grady, B. S. Gupta, S. M. Hudson, T. J. Little, C. D. Livengood, G. N. Mock, H. G. Olf, W. Oxenham, S. T. Purrington, J. P. Rust, C. B. Smith, M. W. Suh, M. H. Theil; **Professors Emeriti:** J. F. Bogdan, D. M. Cates, D. W. Chaney, J. A. Cuculo, R. D. Gilbert, D. S. Hamby, S. P. Hersh, P. R. Lord, R. McGregor, M. H. M. Mohamed, H. A. Rutherford, V. T. Stannett, W. C. Stuckey Jr., C. Tomasinio, P. A. Tucker Jr., W. K. Walsh, W. M. Whaley, S. C. Winchester Jr., C. F. Zorowski; **Associate Professors:** C. M. Balik, P. Banks-Lee, T. K. Ghosh, C. B. Gorman, H. Hamouda, H. H. A. Hergeth, W. J. Jasper, S. A. Khan, J. W. Rucker, A. M. Seyam, R. A. Venditti; **Associate Professors Emeriti:** T. G. Rochow; **Assistant Professors:** M. G. McCord, Y. Qiu

Fiber and polymer science is a multidisciplinary program bringing together the disciplines of mathematics, chemistry and physics and the application of engineering principles for the development of independent scholars versed in all aspects of fiber materials science. Thus, fiber and polymer science is concerned with the formation of and the mechanical, physical and chemical properties of polymeric materials, fibers produced from them, fiber assemblies in one-, two- and three-dimensional forms, and fiber reinforced composites, as well as the utilization thereof.

Admission Requirements: Students majoring in the physical sciences, engineering, mathematics, textiles and having a master's degree will normally qualify for admission. For exceptionally qualified students, the master's degree requirement may be waived, and the student can be admitted directly into the Ph.D. program.

Doctoral Degree Requirements: Credit-hour requirements for the Doctor of Philosophy degree are 72. (Up to 18 hours from an M.S. may be applied against the 72.) Students are admitted to candidacy for the Ph.D. degree after passing a series of written cumulative examinations, completing a scholarly critique of existing knowledge in the field of specialization, and orally defending a research proposal. A written examination in a minor field may be accepted in place of the scholarly critique. They must also have passed an English technical writing course during their college career.

Student Financial Support: Financial aid in the form of assistantships and fellowships is normally available for all full-time students.

Other Relevant Information: In 1991, the College of Textiles moved to its new 298,000 square foot complex, now valued at over \$50 million, which houses exceptional teaching, research, computer, and library facilities. With a graduate faculty of 45 and over \$7,000,000 spent on research in 1997, opportunities abound ranging from preserving the local environment (research sponsored by EPA) to exploring outer space (Mars Mission Research Center sponsored by NASA).

COURSE OFFERINGS (Extensive use may be made of graduate course offerings in other colleges on campus when developing the minor field.)

GENERAL COURSES

FPS(TT) 720 Yam Production/Properties: Advanced Topics.
FPS(TT) 750 Advances in Woven Fabric Formation and Structure.
FPS 781 Mechanics of Twisted Structures.
FPS 782 Mechanics of Fabric Structures.
FPS(TE, TMS) 792 Special Topics in Fiber Science.
FPS 801 Seminar.
FPS 830 Independent Study.
FPS 876 Special Projects in Fiber and Polymer Science.
FPS 885 Doctoral Supervised Teaching.
FPS 890 Doctoral Preliminary Examination.
FPS 893 Doctoral Supervised Research.
FPS 895 Doctoral Dissertation Research.
FPS 896 Summer Dissertation Research.
FPS 899 Doctoral Dissertation Preparation.
TC 704 Fiber Formation--Theory and Practice.
TC(CH,MAT) 762 Physical Chemistry of High Polymers--Bulk Properties.
TC 791 Special Topics in Textile Science.
TMS 500 Fiber and Polymer Microscopy.
TMS(FPS) 761 Mechanical and Rheological Properties of Fibrous Material.
TMS(FPS, MAT) 763 Characterization of Structure of Fiber Forming Polymers.

COURSES IN AREAS OF SPECIALIZATION

Polymer Chemistry and Synthesis

TC 530 The Chemistry of Textile Auxiliaries.
TC(MAT) 561 Organic Chemistry of Polymers.
TC 720 Chemistry of Dyes and Color.
TC 721 Dye Synthesis Laboratory.
TC 525 Dyeing Cellulose.

Polymer Physics and Physical Chemistry

TC 504 Fiber Formation--Theory and Practice.
TC 705 Theory of Dyeing.
TC(CH,MAT) 762 Physical Chemistry of High Polymers--Bulk Properties.
TC(CHE) 769 Polymers, Surfactants and Colloidal Materials.
TC(CH,MAT) 772 Physical Chemistry of High Polymers--Solution Properties.
TC(CHE) 779 Diffusion in Polymers.
TC(FPS,TE,TMS) 792 Special Topics in Fiber Science.
TMS 500 Fiber and Polymer Microscopy.

Mechanics of Textile Materials and Processes

FPS(TE,TT) 781 Mechanics of Twisted Structures.
FPS(TE,TT) 782 Mechanics of Fabric Structures.
TMS(TE, FPS) 765 Textile Composites.
TT(TE) 520 Yarn Processing Dynamics.
TT(TE) 549 Warp Knit Engineering and Structural Design.
TT(TE) 550 Production Mechanics and Properties of Woven Fabrics
TT(FPS,TE) 720 Yarn Production Properties.

Fisheries and Wildlife Sciences

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Fisheries and Wildlife Sciences			Y		Y	

GRADUATE FACULTY

Director of Graduate Programs:

B. J. Copeland, Box 7617, 515.4589, bj_copeland@ncsu.edu, Zoology
S. E. McKeand, Box 8002, 515.7563, steve_mckeand@ncsu.edu, Forestry

Professors: G. T. Barthalmus, P. T. Bromley, B. J. Copeland, P. D. Doerr, J. E. Easley Jr., E. C. Franklin, J. F. Gilliam, E. J. Jones, R. A. Lancia, T. M. Losordo, J. M. Miller, R. L. Noble, K. H. Pollock, R. A. Powell, J. A. Rice, C. V. Sullivan; **Adjunct Professors:** L. B. Crowder; **Associate Professors:** J. M. Hinshaw, R. G. Hodson; **Associate Professors (USDI/USFS):** J. A. Collazo, J. E. Hightower, T. R. Simons; **Assistant Professors:** R. J. Borski, J. Godwin, G. R. Hess, P. S. Rand

The fisheries and wildlife sciences degrees are offered through the Fisheries and Wildlife Science program, an intercollegiate program administered by the Departments of Forestry and Zoology. The degrees emphasize assessment, biology, ecology and management of fish and wildlife species and their habitats.

Admissions Requirements: Application for admission is made through the Departments of Forestry or Zoology. Minimum requirements include a graduate record examination score of 1000 on the verbal and quantitative sections. Admission is contingent upon acceptance by an advisor. Exceptions to minimum requirements may be made for students with special backgrounds.

Master's Degree Requirements: The Master of Fisheries and Wildlife Sciences degree consists of a minimum of 36 credits, which may include up to eight hours of special problems and seminars. A professional paper is required. The M.S. degree program may include up to eight hours of research and seminars. A research-based thesis is required. Further requirements may be imposed by the advisory committee and/or department.

Student Financial Support: Graduate research and teaching assistantships are offered for qualified students through participating departments. Commitments for assistantships are normally made at the time of admission to graduate study.

Other Relevant Information: Research near campus is facilitated by excellent field, laboratory and computer resources. Off-campus research is conducted at the Pamlico Aquaculture Field Laboratory, research and extension centers in the east and west, and at facilities of state and federal agencies and private organizations.

GRADUATE COURSES

FW(ZO) 515 Fish Physiology.
FW(ZO) 553 Principles of Wildlife Science.
FW(ZO) 554 Wildlife Field Studies.
FW(FOR) 585 Advanced Wildlife Habitat Management.
FW(ZO) 586 Aquaculture I.
FW(ZO) 587 Aquaculture I Laboratory.
FW(FOR) 602 Seminar in Wildlife Management.
FW 685 Master's Supervised Teaching.
FW 690 Master's Examination.
FW 693 Master's Supervised Research.
FW 695 Master's Thesis Research.
FW 696 Summer Thesis Research.
FW 699 Master's Thesis Preparation.

COURSES FROM ASSOCIATED DEPARTMENTS

ZO 501 Ornithology.
ZO(ENT) 509 Ecology of Stream Invertebrates
ZO 519 Limnology.
ZO 542 Herpetology.
ZO 544 Mammalogy.
ZO(MEA) 550 Principles of Biological Oceanography.
ZO 603 Aquatic Ecology Seminar.
ZO(ST) 710 Sampling Animal Populations.
ZO 721 Fishery Science.
ZO 726 Quantitative Fisheries Management.
ZO(MEA) 756 Ecology of Fishes.
ZO 784 Advanced Topics in the Study of Mammals.
ZO 789 Advanced Limnology.

Food Science

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Food Science	Y		Y		Y	

GRADUATE FACULTY

K. R. Swartzel, *Head of the Department*

Director of Graduate Programs:

J. C. Allen, Box 7624, 513.2257, jon_allen@ncsu.edu

William Neal Reynolds Professor: T. R. Klaenhammer, H. E. Swaisgood, K. R. Swartzel

Professors: J. C. Allen, D. E. Carroll Jr., G. L. Catignani, P. A. Curtis, E. A. Foegeding, A. P. Hansen, T. C. Lanier, D. K. Larick, J. L. Oblinger, J. E. Rushing, L. G. Turner, C. Waites, D. R. Ward; ***Professors (USDA):*** H. P. Fleming, R. F. McFeeters, T. H. Sanders; ***Professors Emeriti:*** L.

W. Aurand, H. R. Ball Jr., T. A. Bell, T. N. Blumer, R. E. Carawan, E. S. Cofer, P. M. Foegeding, A. M. Fraser, M. E. Gregory, M. W. Hoover, I. D. Jones, V. A. Jones, D. H. Pilkington, W. M. Roberts, S. J. Schwartz, M. L. Speck, F. R. Tarver Jr., F. B. Thomas, W. M. Walter Jr.; *Associate Professors*: L. C. Boyd, B. E. Farkas, D. P. Green, L. Jaykus, S. Kathariou; *Assistant Professors*: C. R. Daubert, K. M. Keener, K. P. Sandeep; *Assistant Professors (USDA)*: F. Breidt

ASSOCIATE MEMBERS OF THE PROGRAM

Professors: H. M. Hassan, T. J. Hoban, C. J. Lackey, B. W. Sheldon; *Professors (USDA)*: H. E. Pattee; *Associate Professors*: K. E. Anderson, S. A. Hale, S. A. Khan

The department's professional activities include teaching, research, and extension functions. The program provides an educational, research, and informational center in food science for North Carolina and the nation. The department also houses three research centers, the Southeast Dairy Foods Research Center, the Center for Advanced Processing and Packaging Studies and the Michael Foods Single Sponsored Laboratory. Course offerings and research facilities are available in the following areas: chemistry-biochemistry, engineering, microbiology, nutrition and processing technology.

Admissions Requirements: To be admitted, a student should be a graduate of an accredited program in food science or the equivalent. Graduates of other majors can be admitted but will be required to make up certain undergraduate deficiencies without graduate credit. The best qualified applicants will be accepted up to the number of spaces that are available for new students.

Master's Degree Requirements: A master's program must include courses from at least two of the following categories: chemistry-biochemistry, engineering, microbiology, nutrition and processing technology. A minor is required. Credits for the minor are variable depending upon the requirements of the minor department or program.

Doctoral Degree Requirements: A doctoral program must include courses from at least three of the categories listed above (or equivalent courses at another university). Courses must be selected from groups embracing one principal subject of concentration, the major, and from a cognate field, the minor. Total course credits will vary depending on the needs of the student. All doctoral students are required to pass a departmentally administered written preliminary exam, designed to evaluate a Ph.D. student's general knowledge and comprehension of food science.

Student Financial Support: Graduate assistantships and other forms of student aid available to students in this program are described elsewhere in the Graduate Catalog.

Other Relevant Information: Students are encouraged to make personal contact with individual faculty whose research program is of interest to them. The department provides a Graduate Studies in Food Science brochure describing each faculty member's program for this purpose. This information is also accessed at <http://www.cals.ncsu.edu/food-science/>

GRADUATE COURSES

FS(FSA) 520 Pre-harvest Food Safety.
FS(FSA) 530 Post-harvest Food Safety.
FS(FSA) 540 Food Safety and Public Health.
FS 553 Food Laws and Regulations.

FS(ANS,NTR) 554 Lactation and Milk Consumption.
FS(FSA) 580 Professional Development and Ethics in Food Safety.
FS 591 Special Problems in Food Science.
FS 592 Special Research Problems in Food Science.
FS 620 Special Problems.
FS 623 Special Research Problems.
FS 685 Master's Supervised Teaching.
FS 690 Master's Examination.
FS 693 Master's Supervised Research.
FS 695 Master's Thesis Research.
FS 696 Summer Thesis Research.
FS 699 Master's Thesis Preparation.
FS 704 Food Proteins and Enzymes.
FS 705 Physical and Chemical Properties of Muscle Foods.
FS(NTR) 706 Vitamin Metabolism.
FS 709 Food Lipids.
FS 722 Microbial Food Safety.
FS(MB) 725 Fermentation Microbiology.
FS(NTR) 730 Human Nutrition.
FS 751 Food Ingredient Technology in Product Development.
FS 753 Food Laws and Regulations.
FS 780 Seminar in Food Science.
FS(BAE) 785 Food Rheology.
FS 791 Special Problems in Food Science.
FS 792 Special Research Problems in Food Science.
FS 820 Special Problems.
FS 823 Special Research Problems.
FS 885 Doctoral Supervised Teaching.
FS 890 Doctoral Preliminary Examination.
FS 893 Doctoral Supervised Research.
FS 895 Doctoral Dissertation Research.
FS 896 Summer Dissertation Research.
FS 899 Doctoral Dissertation Preparation.

Forestry

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Forestry	Y		Y		Y	

GRADUATE FACULTY

F. W. Cubbage, *Head of the Department*

Director of Graduate Programs:

S. E. McKeand, Box 8002, 515.7563, steve_mckeand@ncsu.edu

Carl Alwin Schenck Professor: H. L. Allen, Jr.

Distinguished University Professor: E. B. Cowling

Edwin F. Conger Professor: R. R. Sederoff

Professors: R. I. Bruck, A. W. Cooper, F. W. Cubbage, P. D. Doerr, E. C. Franklin, D. J. Frederick, L. F. Grand, J. D. Gregory, A. E. Hassan, J. B. Jett Jr., E. J. Jones, S. Khorram, R. A. Lancia, R. Lea, J. R. McGraw, S. E. McKeand, R. L. Noble, J. D. Wellman, A. G. Wollum II; **Research Professors:** W. S. Dvorak, T. J. Mullin; **Professors (USDA):** F. E. Bridgwater Jr.; **Adjunct Professors:** S. Anderson, G. L. DeBarr, P. Farnum, S. Linder, J. P. McTague; **Professors Emeriti:** C. B. Davey, J. W. Duffield, D. L. Holley Jr., R. C. Kellison, P. A. Sanchez, B. J. Zobel; **Associate Professors:** R. C. Abt, H. V. Amerson, G. B. Blank, R. R. Braham, L. J. Frampton Jr., B. Goldfarb, J. P. Roise, A. M. Stomp, R. J. Weir, R. W. Whetten; **Research Associate Professors:** B. A. Bergmann, G. R. Hodge, B. Li, B. Liu, D. M. O'Malley, T. H. Shear; **Associate Professors (USDA):** S. G. McNulty; **Associate Professors (USDI/USFS):** M. A. Buford, J. A. Collazo; **Adjunct Associate Professors:** D. L. Bramlett, R. G. Campbell, C. C. Lambeth, D. L. Loftis, K. H. Riitters, J. M. Vose; **Assistant Professors:** R. E. Bardon, H. M. Cheshire, G. R. Hess, C. E. Moorman, D. J. Robison, E. O. Sills; **Research Assistant Professors:** D. L. Kelting, J. P. Siry, G. Sun, Y. T. Yamamoto; **Assistant Professors (USDA):** W. D. Smith; **Visiting Assistant Professors:** R. E. Holman, R. H. Schaberg; **Adjunct Assistant Professors:** M. C. Conner, C. B. Davidson, M. T. Highsmith, T. P. Holmes, K. H. Johnsen, W. E. Ladrach, R. B. McCullough, D. E. Mercer, J. U. Nilsson, S. Pattanayak, J. P. Prestemon, R. C. Purnell, K. R. Roeder, F. G. Sanchez, C. C. Trettin, D. N. Wear, J. Wisniewski, J. A. Wright

ASSOCIATE MEMBERS OF THE PROGRAM

Professors: S. W. Buol, P. T. Bromley, H. A. Devine, F. P. Hain, L. E. Hinesley, R. A. Powell, E. A. Wheeler; **Associate Professors:** L. D. Gustke, B. E. Wilson; **Associate Professors (USDI/USFS):** T. R. Simons; **Adjunct Associate Professors:** W. J. Fleming

The department offers training in all of the major sub-disciplines of forest-related science and management. Considerable flexibility is allowed in developing graduate programs tailored to the student's objectives.

Admission Requirements: All parts of the application, including the GRE general test, are considered in making decisions. Admission is competitive and depends on the willingness of at least one member of the faculty to serve as major professor. An undergraduate degree in forestry is not required.

Master's Degree Requirements: Course work requirements range from 30 to 36 credits depending on the specific master's option. Students without an appropriate background will require additional preparatory work.

Doctoral Degree Requirements:

As a rule, students must complete a master's degree before entering the Ph.D. program. However, exceptionally well-prepared students may petition to have their degree objective changed to Ph.D. before completing the master's degree. In addition to the dissertation, Ph.D. programs typically require 30 credits of course work beyond the master's degree.

Student Financial Support: Merit-based research assistantships are available every year in most fields of specialization. Stipend levels allow students to graduate without incurring significant debt. Those who begin without an assistantship are considered for funding as projects become available.

Other Relevant Information: Every graduate student must meet two requirements: (1) register for a one-credit research methodology course, FOR 603 or 803, in the first semester and (2) begin the final oral exam with a seminar to the department based on work accomplished during the graduate program. Ph.D. students must meet a one-time teaching requirement by assisting a faculty member teach an undergraduate forestry or natural resources course.

GRADUATE COURSES

FOR 501 Dendrology.
FOR 502 Forest Measurements.
FOR 503 Tree Physiology.
FOR 505 Forest Management.
FOR 506 Timber Investment Analysis.
FOR 507 Silviculture Mini Course.
FOR 509 Forest Resource Policy.
FOR 510 Introduction to GPS.
FOR 513 Silviculture for Intensively Managed Plantations.
FOR 519 Forest Economics.
FOR(NR) 520 Watershed and Wetlands Hydrology.
FOR 522 Consulting Forestry.
FOR 534 Forest Operations and Analysis.
FOR 540 Advanced Dendrology.
FOR 554 Principles of Spatial Analysis.
FOR 561 Forest Communities of the Southeastern Coastal Plain.
FOR 562 Forest Communities of the Southern Appalachians.
FOR(SSC) 577 Conservation and Sustainable Development I: Concepts and Methods.
FOR(SSC) 578 Conservation and Sustainable Development II: Integrated Problem Solving.
FOR(SSC) 581 Agroforestry.
FOR 583 Tropical Forestry.
FOR(FW) 585 Advanced Wildlife Habitat Management.
FOR 595 Special Topics.
FOR 601 Graduate Seminar.
FOR(FW) 602 Seminar in Wildlife Management.
FOR 603 Seminar in Forest Research.
FOR 608 Forest Management and Planning.
FOR 610 Special Topics.
FOR 615 Advanced Special Topics.
FOR 680 Field Practicum in Tropical Forestry.
FOR 685 Master's Supervised Teaching.
FOR 690 Master's Examination.
FOR 693 Master's Supervised Research.
FOR 695 Master's Thesis Research.
FOR 696 Summer Thesis Research.
FOR 699 Master's Thesis Preparation.
FOR 701 Advanced Hydrology.
FOR 713 Advanced Topics in Silviculture.
FOR(GN) 725 Forest Genetics.
FOR(GN) 726 Advanced Topics in Quantitative Genetics.
FOR 727 Tree Improvement Research Techniques.
FOR 728 Quantitative Forest Genetics Methods.
FOR 733 Forest Ecosystem Analysis.
FOR 750 Ecological Restoration.
FOR 753 Environmental Remote Sensing.
FOR(ENT) 765 Advanced Forest Entomology.
FOR 772 Forest and Renewable Policies on the Public Lands
FOR 773 Ecophysiology of Forest Production.
FOR 774 Topics in Forest Modeling.
FOR(SSC) 782 Silviculture and Management of Forest Plantations in the Tropics
FOR 784 The Practice of Environmental Impact Assessment
FOR 795 Special Topics.

FOR 801 Seminar.
FOR 802 Seminar in Wildlife Management.
FOR 803 Seminar in Forest Research.
FOR 810 Special Topics.
FOR 815 Advanced Special Topics.
FOR 885 Doctoral Supervised Teaching.
FOR 890 Doctoral Preliminary Examination.
FOR 893 Doctoral Supervised Research.
FOR 895 Doctoral Dissertation Research.
FOR 896 Summer Dissertation Research.
FOR 899 Doctoral Dissertation Preparation.

Functional Genomics

For a listing of graduate faculty and program information, see genomic sciences.

Genetics

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Genetics	Y		Y		Y	

GRADUATE FACULTY

S. E. Curtis, *Head of the Department*

Director of Graduate Programs:

S. E. Curtis, Box 7614, 515.2291, securtis@ncsu.edu

Distinguished University Professor: J. G. Scandalios

William Neal Reynolds Professor: W. R. Atchley, T. F. Mackay

Professors: S. E. Curtis, W. E. Kloos, W. H. McKenzie, H. E. Schaffer, S. L. Spiker; *Adjunct Professors:* M. Chilton; *Professors Emeriti:* W. D. Hanson, C. S. Levings III, T. J. Mann, D. F. Matzinger, R. H. Moll, C. W. Stuber, A. C. Triantaphyllou; *Associate Professors:* T. H. Emigh, J. W. Mahaffey; *Assistant Professors:* G. C. Gibson, M. D. Purugganan, J. C. Swaffield; *Assistant Professors (USDA):* E. S. Buckler IV

ASSOCIATE MEMBERS OF THE PROGRAM

Professors: E. J. Eisen, M. M. Goodman, R. R. Sederoff, W. F. Thompson, B. S. Weir, E. A. Wernsman, R. R. H. Anholt, R. S. Boston, L. K. Hanley-Bowdoin, C. H. Opperman, O. W. Robison; *Research Professors:* S. Zeng

The department provides a well-balanced program of graduate course work and research training. The faculty conducts research in genetics of animals, plants, and bacteria. The student has a choice

of research projects in the broad areas of molecular, biochemical, developmental, quantitative and population genetics.

Admission Requirements: Applicants may come from a number of undergraduate programs that include biological, agricultural, physical and mathematical science training. All applications are screened by a departmental committee, and the best qualified applicants will be accepted up to the number of spaces that are available for new students.

Master's Degree Requirements: A nine-hour sequence of three core courses is required of all majors and minors. A minimum of two additional graduate genetics courses are required.

Doctoral Degree Requirements: A nine-hour sequence of three core courses is required of all majors and minors. A minimum of four additional graduate genetics courses are required.

Student Financial Support: Graduate assistantships and fellowships are available to the students from a number of sources. Information will be provided at the time of application.

Other Relevant Information: New students will rotate through 3 laboratories during their first semester. At the end of the semester, they will choose a laboratory for their research activities consistent with their interests and available research projects. Provisions are available for a co-major and cooperative research in more than one laboratory.

GRADUATE COURSES

GN 504 Human Genetics.
GN 513 Advanced Genetics.
GN 685 Master's Supervised Teaching.
GN 690 Master's Examination.
GN 693 Master's Supervised Research.
GN 695 Master's Thesis Research.
GN 696 Summer Thesis Research.
GN 699 Master's Thesis Preparation.
GN 701 Molecular Genetics.
GN 702 Cellular and Developmental Genetics.
GN 703 Population and Quantitative Genetics.
GN(ANS) 708 Genetics of Animal Improvement.
GN 710 Eukaryotic Regulatory Mechanisms.
GN(ANS) 713 Quantitative Genetics and Breeding.
GN(CS) 719 Origin and Evolution of Cultivated Plants.
GN(CS,HS) 720 Molecular Biology in Plant Breeding.
GN(ST) 721 Genetic Data Analysis.
GN(FOR) 725 Forest Genetics.
GN(FOR) 726 Advanced Topics in Quantitative Genetics.
GN(BO,MB,PP) 730 Fungal Genetics and Physiology.
GN(ZO) 740 Evolutionary Genetics.
GN(CS,HS) 741 Plant Breeding Methods.
GN(CS,HS) 745 Quantitative Genetics in Plant Breeding.
GN(CS,HS) 746 Breeding Methods.
GN(CS,HS,PP) 748 Breeding for Pest Resistance.
GN 750 Developmental Genetics.
GN 755 Population Genetics.
GN(ST) 756 Computational Molecular Evolution.
GN(BLST) 757 Statistics for Molecular Quantitative Genetics.
GN(MB) 758 Prokaryotic Molecular Genetics.
GN(MB) 760 Experimental Microbial Genetics
GN(BCH) 761 Advanced Molecular Biology of the Cell.

GN(BCH) 768 Nucleic Acids: Structure and Function.

GN(ST) 770 Statistical Concepts in Genetics.

GN 793 Special Topics in Genetics.

GN 801 Seminar.

GN 809 Colloquium.

GN 810 Special Topics in Genetics.

GN 820 Special Problems.

GN(CS,HS) 860 Plant Breeding Laboratory.

GN(CS,HS) 861 Plant Breeding Laboratory.

GN 885 Doctoral Supervised Teaching.

GN 890 Doctoral Preliminary Examination.

GN 893 Doctoral Supervised Research.

GN 895 Doctoral Dissertation Research.

GN 896 Summer Dissertation Research.

GN 899 Doctoral Dissertation Preparation.

Genomic Sciences

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Bioinformatics	Y				Y	
Functional Genomics	Y		Y		Y	

GRADUATE FACULTY

Director of Graduate Programs:

S. E. Curtis, Box 7614, 515.2291, securtis@ncsu.edu

Distinguished University Professor and William Neal Reynolds Professor: M. M. Goodman

Distinguished University Research Professor: D. L. Bitzer

Glaxo Distinguished University Professor: J. S. Lindsey

Graduate Alumni Distinguished Professor: W. A. F. Tompkins

University Research Professor: W. F. Thompson

William Neal Reynolds Professor: W. R. Atchley, E. J. Eisen, T. R. Klaenhammer, T. F. Mackay, B. S. Weir

Professors: P. F. Agris, R. R. H. Anholt, W. F. Boss, R. S. Boston, E. B. Breitschwerdt, D. T. Brown, G. Cole, S. E. Curtis, M. E. Daub, M. Davidian, F. J. Fuller, L. K. Hanley-Bowdoin, E. L. Kaltofen, D. H. Ley, S. A. Lommel, E. S. Maxwell, S. E. McKeand, J. W. Moyer, C. H. Opperman, P. E. Orndorff, G. A. Payne, R. M. Petters, T. H. Regan, R. C. Smart, C. V. Sullivan, A. A. Tsiaatis, P. L. Wollenzien; **Research Professors:** S. Leath, S. Zeng; **Associate Professors:** H. V. Amerson, P. Arasu, D. M. Bird, J. W. Brown, S. D. Clouse, R. E. Dewey, R. A. Dwyer, C. E. Farin, L. J. Frampton Jr., J. E. Gadsby, B. Goldfarb, J. M. Hughes-Oliver, S. Kathariou, J. W. Mahaffey, E. S. Miller, J. N. Petitte, J. B. Ristaino, D. Robertson, B. Sherry, I. W. Smoak, J. L. Thorne, B. Wang, R. W. Whetten; **Research Associate Professors:** J. M. Horowitz, B. Li, B. Liu, D. M. O'Malley; **Assistant Professors:** S. R. Browning, G. A. Dean, T. C. Elston, S. K. Ghosh, G. C. Gibson, J. Godwin, J. M. Haugh, D. E. Malarkey, C. Mattos, A. M. Miles, P. E. Mozdziak, S. V. Muse, M. D. Purugganan, M. C. Sagui, N. J. H. Sharp, J. C. Swaffield, B. M. Wiegmann, D.

Zhang; Research Assistant Professors: J. B. Allen, L. D. Martin, D. M. Nielsen; **Assistant Professors (USDA):** E. S. Buckler IV; **Visiting Assistant Professors:** A. C. Clark, A. White

Genomic sciences has two components. Functional genomics, the generation of large bodies of data relating to organism function, encompasses gene discovery, gene expression, protein and nucleic acid structure and function, gene and gene product interactions, and genomic approaches to breeding and comparative studies relevant to ecology and evolutionary biology. Bioinformatics is the analysis of these vast and complex data sets including methods to analyze extremely large sets of genomic information such as DNA sequences and expression from DNA microassays. Students register in either of these two field but also receive a solid grounding in the other through core courses common to both programs.

Admission Requirements: Students should have an undergraduate major in the biological or physical sciences, mathematics, statistics or computer science and have completed calculus and other comparable courses. In addition to the other application requirements, a student should submit a statement of interests and career goals.

Master's Degree Requirements: Students take a 15-credit core curriculum of courses common to both programs followed by courses specific to the degree and discipline.

Doctoral Degree Requirements: The Ph.D. program requires a total of 72 credits, and all students participate in a journal club, monthly seminar series and research ethics training. A co-mentoring system exists between bioinformatics and functional genomics through which each student has advisors from both disciplines. and throughout the program they will have the opportunity to gain practical experience in the Genome Research Laboratory, Bioinformations Research Center and DNA Sequencing Facility.

Student Financial Support: A significant number of fellowships are available through the genomics program, and students may also be supported by research grant funds awarded to genomics faculty members.

GRADUATE COURSES

- BI 601 Seminar.
- BI 610 Special Topics.
- BI 615 Advanced Special Topics.
- BI 685 Master's Supervised Teaching.
- BI 690 Master's Examination.
- BI 693 Master's Supervised Research.
- BI 695 Master's Thesis Research.
- BI 696 Summer Thesis Research.
- BI 699 Master's Thesis Preparation.
- BI(GN,ST) 757 Statistics for Molecular Quantitative Genetics.
- BI 801 Seminar.
- BI 810 Special Topics.
- BI 815 Advanced Special Topics.
- BI 885 Doctoral Supervised Teaching.
- BI 890 Doctoral Preliminary Examination.
- BI 893 Doctoral Supervised Research.
- BI 895 Doctoral Dissertation Research.
- BI 896 Summer Dissertation Research.
- BI 899 Doctoral Dissertation Preparation.

Graphic Design

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Graphic Design					Y	

GRADUATE FACULTY

M. J. Davis, *Head of the Department*

Director of Graduate Programs:

M. J. Davis, Box 7701, 515.8328, meredith_davis@ncsu.edu

Professors: M. J. Davis, V. M. Foote, H. Khachatoorian, A. S. Lowrey, M. Scotford; **Associate Professors:** K. L. Bailey, S. Townsend; **Associate Professors Emeriti:** A. V. Cooke; **Assistant Professors:** P. A. Brock

Recognizing that graphic design is both a social activity and a form of cultural production, faculty and students in the Department of Graphic Design define the study of the discipline as necessarily contextual; graduate research examines the creation, reproduction, distribution, and reception of design from a multidisciplinary perspective. The Master of Graphic Design Program also emphasizes the importance of understanding design as the creation of cognitive and cultural artifacts; study focuses on the construction of messages, the reproduction of such artifacts, the systems for their distribution, and their reception within various cultures of society.

Graduate students in graphic design learn through their own search for problems within critical content frameworks presented by the faculty. The program places primary importance on the ability of students to be critical agents; to seek problems and to pose questions. Faculty evaluate graduate students on their capacity to define individual investigations and to support their decision-making with an independent program of reading and research; on their ability to critically evaluate and articulate discoveries; and on their skills in synthesizing ideas through the creation of design artifacts.

The Master of Graphic Design Program provides focused study and research in the discipline that reflects concern for how designers will shape and respond to the changing technological and social communications environments of the future. The Program has the broad objective to educate socially responsible, intellectually curious, historically aware, and technologically adept communication design professionals.

In the Track III Program, students whose undergraduate preparation is in fields other than graphic design examine relationships between their previous study and graphic design. While acquiring design skills and knowledge in graphic design, they apply concepts and methods from their previous study to design research and innovation.

Admissions Requirements: Students must make application to the Department of Graphic Design

by January 15. In addition to Graduate School requirements, the department requires department personal data forms and a slide portfolio of design and two-dimensional visual work.

Master's Degree Requirements: Studio credits presented for transfer must be accompanied by a portfolio of work from the courses under consideration.

Student Financial Support: The department has limited provisions for tuition remission and assistantships. Assistantships are awarded on the basis of student and departmental needs. Assistantship applications are available from the Department of Graphic Design and should be submitted with the application for admission (for incoming students) or by the advertised deadline (for continuing students).

GRADUATE COURSES

GD 501 Graduate Graphic Design Studio I.
GD 502 Graduate Graphic Design Studio II.
GD 503 Graduate Graphic Design Studio III.
GD 517 Advanced Typographic Systems.
GD 518 Advanced Typographic Expression.
GD 570 Theory in Practice: Graphic Design since 1945.
GD 571/DDN 771 Design as Cognitive Artifact.
GD 572/DDN 772 Design as Cultural Artifact.
GD 573/DDN 773 New Information Environments.
GD 580 Special Topics in Graphic Design History.
GD 581 Graphic Design Final Project Research.
GD 588 Final Project Studio in Graphic Design.
GD 592 Special Topics in Graphic Design.
GD 610 Special Topics in Graphic Design.
GD 630 Independent Study in Graphic Design.
GD 676 Special Project in Graphic Design.
GD 685 Master's Supervised Teaching.
GD 690 Master's Examination.

Health Occupations Teacher Education

For a listing of graduate faculty and program information, see adult and community college education.

Higher Education Administration

For a listing of graduate faculty and program information, see adult and community college education.

History

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
History				Y		
Public History				Y		

GRADUATE FACULTY

A. J. LaVopa, *Head of the Department*

Director of Graduate Programs:

D. A. Zonderman, Box 8108, 515.2483, zonderman@social.chass.ncsu.edu

Graduate Alumni Distinguished Professor: J. D. Smith

Professors: J. R. Banker, C. H. Carlton, A. J. De Grand, D. P. Gilmartin, W. C. Harris, J. P. Hobbs, O. J. Kalinga, A. J. LaVopa, L. O. McMurry, G. W. O'Brien, J. K. Ocko, J. M. Riddle, R. H. Sack, R. W. Slatta, E. D. Sylla, K. S. Vincent; *Professors (USDA):* S. T. Parker; *Professors Emeriti:* B. F. Beers, M. L. Brown Jr., M. S. Downs, R. W. Greenlaw, D. E. King, M. E. Wheeler, B. W. Wishy; *Associate Professors:* J. E. Crisp, W. A. Jackson III, W. C. Kimler, K. P. Luria, S. Middleton, A. W. N. Mitchell, S. L. Spencer, G. D. Surh, P. Tyler, K. P. Vickery, D. A. Zonderman; *Associate Professors Emeriti:* R. N. Elliott; *Assistant Professors:* D. Ambaras, R. K. Bassett, H. Brewer, A. F. Khater; *Visiting Assistant Professors:* J. C. Bonham; *Adjunct Assistant Professors:* W. Atkins, V. Berger, J. W. Caddell

Admission Requirements: In the required career goals statement, the major country, topic and historical period of interest should be included. Students admitted provisionally must complete at least 9 hours of graduate courses making grades of A or B to be considered for full graduate standing.

Master's Degree Requirements: Master of Arts Degree in History: This program requires at least twenty-four hours of course work and a thesis. Each student's program is tailored to enhance his or her career objectives. Social studies teachers, for example, may earn advanced competency on completion of the M.A. in history with additional course work in education. Similarly, students who plan to pursue a Ph.D. degree receive the requisite training and assistance. Master of Arts Degree in Public History: This non-thesis program requires thirty-six hours of course work. Half the hours fall in historical studies, the rest in applied history classes, including innovative courses in iconographic materials and archival conservation, documentary editing, and museology. Students may select a practicum that places them under the direct supervision of the State Archivist of North Carolina. Students may select another practicum in their own special area of interest--including historic site administration, museology, historic preservation, or historical publications.

Student Financial Support: Graduate assistantships and fellowships are available to students in

both programs and are awarded by open competition.

Other Relevant Information: Application deadline is January 15; students are admitted for the fall semester only. The general portion of the GRE is required for those seeking admission to both the history and public history programs. No subject test is required for either program.

GRADUATE COURSES

- HI 500 Civilizations of the Ancient Near East.
- HI 504 Rome to 337 A.D.
- HI 505 History and Archaeology of the Roman Empire.
- HI 506 From Roman Empire to Middle Ages.
- HI 507 Islamic History to 1798.
- HI 509 The High Middle Ages.
- HI 510 Italian Renaissance.
- HI 511 The Protestant and Catholic Reformation of the 16th Century.
- HI 514 France in the Old Regime.
- HI 515 Revolutionary Europe.
- HI 518 Fascist Italy and Nazi Germany.
- HI 519 Modern European Imperialism.
- HI 520 European Diplomatic History.
- HI 521 European Intellectual History: The Eighteenth Century.
- HI 522 European Intellectual History: The 19th Century.
- HI 525 Tudor and Stuart England.
- HI 529 20th Century Britain.
- HI 530 Modern France.
- HI 531 Germany: Luther to Bismarck 1500-1871.
- HI 532 History of Germany Since 1871.
- HI 538 The Russian Empire to 1917.
- HI 539 History of the Soviet Union and After.
- HI 541 Colonial and Revolutionary U. S.
- HI 543 U. S. Constitutional History.
- HI 546 Civil War and Reconstruction.
- HI(WGS) 547 History of American Women to 1900.
- HI(WGS) 548 American Women in the Twentieth Century.
- HI 549 U. S. Labor to 1900.
- HI 550 U. S. Labor Since 1900.
- HI 552 Recent America.
- HI 553 U. S.-Latin American Relations Since 1823.
- HI 554 History of U. S. Foreign Relations, 1900-Present.
- HI 555 History of the Civil Rights Movement.
- HI 556 Early American Thought.
- HI 557 Twentieth-century U. S. Intellectual History.
- HI 558 Modern American Historical Biography.
- HI(REL) 560 American Religion after Darwin.
- HI 561 Civilization of the Old South.
- HI 562 Social History of the New South.
- HI 564 Topics in the History of North Carolina.
- HI 569 Latin American Revolutions in the Twentieth Century.
- HI 571 Revolutionary China.
- HI 573 Japan's Empire in Asia, 1868-1945.
- HI 575 History of the Republic of South Africa.
- HI 576 Leadership in Modern Africa.
- HI 579 Africa (Sub-Saharan) in the Twentieth Century.
- HI 580 Scientific Revolution: 1300-1700.
- HI 581 History of Life Sciences.
- HI 582 Darwinism in Science and Society.
- HI 583 Science and Religion in European History.
- HI 584 Science in European Culture.
- HI 586 History and Principles of the Administration of Archives and Manuscripts.

- HI 587 Application of Principles of Administration of Archives and Manuscripts.
 HI 588 Conservation of Archival and Library Materials.
 HI 589 Automation and Public History.
 HI 590 Documentary Editing and Historical Publication.
 HI 591 Introduction to Museology.
 HI 592 Advanced Museology.
 HI 593 Material Culture.
 HI 596 Introduction to Public History.
 HI 597 Historiography and Historical Method.
 HI 598 Historical Writing.
 HI 599 Independent Study.
 HI 642 Practicum in Public History.
 HI 685 Master's Supervised Teaching.
 HI 690 Master's Examination.
 HI 693 Master's Supervised Research.
 HI 695 Master's Thesis Research.
 HI 696 Summer Thesis Research.
 HI 699 Master's Thesis Preparation.

Horticultural Science

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Horticultural Science	Y		Y		Y	

GRADUATE FACULTY

T. J. Monaco, *Head of the Department*

Director of Graduate Programs:

S. L. Warren, Box 7609, 515.1193, stu_warren@ncsu.edu

Graduate Alumni Distinguished Professor: D. M. Pharr

Professors: J. R. Ballington Jr., T. E. Bilderback, S. M. Blankenship, F. A. Blazich, A. A. De Hertogh, P. R. Fantz, W. C. Fonteno II, R. G. Gardner, L. E. Hinesley, W. E. Hooker, R. E. Lyons, T. J. Monaco, P. V. Nelson, M. M. Peet, E. B. Poling, M. A. Powell Jr., D. C. Sanders, C. R. Unrath, S. L. Warren, T. C. Wehner, D. J. Werner, L. G. Wilson, E. Young; *Adjunct Professors:* W. W. Collins; *Professors Emeriti:* W. E. Ballinger, F. D. Cochran, F. L. Haynes Jr., W. R. Henderson, J. M. Jenkins, T. R. Konsler, R. A. Larson, J. W. Love, C. M. Mainland, C. H. Miller, D. T. Pope, W. A. Skroch; *Associate Professors:* J. D. Burton, S. D. Clouse, J. M. Davis, J. M. Dole, D. W. Monks, J. C. Neal, M. L. Parker, T. G. Ranney, J. R. Schultheis; *Research Associate Professors:* J. D. Williamson; *Adjunct Associate Professors:* P. S. Zorner; *Associate Professors Emeriti:* T. F. Cannon; *Assistant Professors:* W. G. Buhler, N. G. Creamer, G. E. Fernandez, B. E. Whipker, G. C. Yencho; *Adjunct Assistant Professors:* F. C. Wise; *Lecturers:* M. E. E. Traer

ASSOCIATE MEMBERS OF THE PROGRAM

Professors: D. E. Carroll, Jr.; **Professors Emeriti:** R. Aycock, R. H. Moll, R. L. Mott; **Assistant Professors:** F. H. Yelverton

Course offerings or research facilities are available in the following areas: plant physiology, breeding and genetics, herbicide physiology, nutrition, propagation, tissue culture, biotechnology, growth regulators, postharvest physiology, control of environment, agricultural meteorology, Christmas tree research, landscape horticulture and biochemistry of varietal differences.

Admission Requirements: At the discretion of a graduate program, a student may be admitted provisionally for graduate study in a program without the GRE scores. To be admitted, a student should have completed course work in physics, mathematics, chemistry, soils, plant pathology, genetics, entomology and several courses in horticulture. An applicant deficient in course work may be admitted on a provisional basis until the deficiency is made up.

Master's Degree Requirements: For the Master of Science degree, the program must include four credit hours of the horticultural science core courses, seminar preparation, and presentation of one seminar, and teaching and outreach experiences.

Doctoral Degree Requirements: The program must include three credit hours of the horticultural science core courses, seminar preparation, presentation of two seminars, and teaching and outreach experiences. The preliminary comprehensive examination consists of written and oral examinations. The Ph.D. requires research and a thesis which is defended orally during the final examination.

Student Financial Support: The department has a number of graduate teaching and research assistantships available for promising students; these include Agricultural Foundation and Experiment Station assistantships. Those interested should apply at least nine months prior to their anticipated enrollment date.

GRADUATE COURSES

HS(PP,CS) 502 Plant Disease: Methods and Diagnosis.

HS 525 Advanced Plant Propagation.

HS 590 Special Problems in Horticultural Science.

HS 610 Special Topics.

HS 615 Advanced Special Topics.

HS 685 Master's Supervised Teaching.

HS 690 Master's Examination.

HS 691 Research Principles.

HS 693 Master's Supervised Research.

IIS 695 Master's Thesis Research.

HS 696 Summer Thesis Research.

HS 699 Master's Thesis Preparation.

HS 701 Carbohydrate Metabolism and Transport.

HS 703 Breeding Asexually Propagated Crops

HS 704 Plant Nomenclature.

HS 705 Physiology of Flowering.

HS 706 Fruit Development and Postharvest Physiology.

HS 707 Environmental Stress Physiology.

HS(CS) 715 Weed Science Research Techniques.

HS(CS) 716 Weed Biology.

HS(CS) 717 Weed Management Systems.
HS(CS) 718 Biological Control of Weeds.
HS(CS,GN) 720 Molecular Biology in Plant Breeding.
HS 722 Mineral Nutrition in Plants.
HS(CS,SSC) 725 Herbicide Chemistry.
HS(CS,SSC) 727 Herbicide Behavior in Soil and Water.
HS(CS) 729 Herbicide Behavior in Plants.
HS 731 Physiology of Landscape Plants.
HS 732 Vegetable Crop Physiology.
HS 734 Vegetable Crops Practicum.
HS(CS,GN) 741 Plant Breeding Methods.
HS(CS,GN) 745 Quantitative Genetics in Plant Breeding.
HS(CS,GN) 746 Breeding Methods.
HS(CS,GN,PP) 748 Breeding for Pest Resistance.
HS 790 Special Problems in Horticultural Science.
HS 801 Seminar.
HS 815 Advanced Topics.
HS(CS,GN) 860 Plant Breeding Laboratory.
HS(CS,GN) 861 Plant Breeding Laboratory
HS 885 Doctoral Supervised Teaching.
HS 890 Doctoral Preliminary Examination
HS 891 Research Principles
HS 893 Doctoral Supervised Research.
HS 895 Doctoral Dissertation Research.
HS 896 Summer Dissertation Research.
HS 899 Doctoral Dissertation Preparation.

Immunology

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Immunology	Y		Y		Y	

GRADUATE FACULTY

Director of Graduate Programs:

W. A. F. Tompkins, Box 8401, 513.6262, wayne_tompkins@ncsu.edu

Graduate Alumni Distinguished Professor: W. A. F. Tompkins

Professors: P. F. Agris, G. W. Almond, E. B. Breitschwerdt, T. T. Brown Jr., P. B. Carter, E. V. De Buyscher, F. W. Edens, F. J. Fuller, B. Hammerberg, M. G. Levy, L. E. Perryman, M. A. Qureshi, M. B. Tompkins; **Visiting Professors:** E. A. Havell; **Professors Emeriti:** L. Coggins, J. G. Lecce; **Associate Professors:** P. Arasu, L. C. Hudson, S. M. Laster, M. B. McCaw, B. Sherry, S. L. Tonkonogy; **Research Associate Professors:** S. Kennedy-Stoskopf; **Assistant Professors:** M. J. Burkhard, G. A. Dean, S. L. Jones, T. B. Kepler, S. J. Libby, T. Olivry; **Research Assistant Professors:** J. B. Allen

Course offerings or research facilities are available in the following areas: immunogenetics, immunopathology, immunotoxicology, immunoparasitology, mucosal immunology, molecular

and infectious disease immunology, molecular genetics, aquatic immunology and environmental immunology.

Admission Requirements: Students will be accepted into the immunology program based on their academic records (GPA) as undergraduates and/or as veterinary or medical students, results of the GRE, letters of recommendation and expression of interest in immunology. For the Ph.D. program, special consideration will be given to students who have had research experience (either an M.S. degree or other laboratory experience), especially in immunology, microbiology, biochemistry or genetics, or students who are completing strong clinical residency programs. Completed applications should be received by December 1 for fall admission.

To be admitted, a student should be a graduate of a major accredited biological science or medical science program. Students lacking appropriate courses may be considered for admission but will be required to make up certain undergraduate deficiencies without graduate credit.

Master's Degree Requirements: Courses must include at least two 700-800-level immunology courses and one 700-800-level core biochemistry course.

Doctoral Degree Requirements: Generally, Ph.D. students should take 22 credit hours to satisfy the course requirements of the program. These include at least two 700-800-level immunology courses, one 700-800-level biochemistry course and the core course in biotechnology (BIT 860). Additional courses in the biotechnology series are recommended. The remaining credit hours (8-10) should include journal club (IMM 816), seminar (IMM 807) and research credits.

Student Financial Support: Graduate assistantships are available to students in the immunology program through the affiliated departments and graduate training grants. In addition, there are graduate research assistantships provided by individual faculty of the program.

Other Relevant Information: The immunology program is an interdepartmental graduate program with faculty drawn from the College of Veterinary Medicine and the College of Agriculture and Life Sciences' Departments of Biochemistry, Microbiology and Poultry Science. For administrative purposes, all students accepted into the program will also have to be student members of one of the participating departments.

GRADUATE COURSES

IMM 685 Master's Supervised Teaching.

IMM 690 Master's Examination.

IMM 693 Master's Supervised Research.

IMM 695 Master's Thesis Research.

IMM 696 Summer Thesis Research.

IMM 699 Master's Thesis Preparation.

IMM(TOX) 705 Immunotoxicology.

IMM(MB) 751 Immunology.

IMM(CBS) 755 Immunoparasitology.

IMM(CBS,MB,PHY,PO) 756 Immunogenetics.

IMM(PO) 757 Avian Immunology.

IMM(CBS,MB) 783 Advanced Immunology.

IMM(CBS) 807 Seminar in Veterinary Microbiology/ Immunology

IMM(CBS) 816 Advanced Topics in Immunology and Biotechnology.

IMM 885 Doctoral Supervised Teaching.

IMM 893 Doctoral Supervised Research.

IMM 895 Doctoral Dissertation Research.

Industrial Design

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Industrial Design					Y	

GRADUATE FACULTY

H. Khachatoorian, *Head of the Department*

Director of Graduate Programs:

B. W. Laffitte, Box 7701, 515.8333, bwlaffit@unity.ncsu.edu

Professors: G. E. Lewis; *Associate Professors:* C. D. Cox, L. M. Diaz, B. W. Laffitte; *Assistant Professors:* P. R. Hooper

Industrial Design is the professional service of creating and developing concepts and specifications that optimize the value, function and appearance of products and product systems to the mutual benefit of both user and manufacturer. This service is often provided in the context of a cooperative working relationship with other members of a development group.

Typical groups include management, marketing, engineering and manufacturing specialists. Industrial designers place special emphasis on human characteristics, needs and interests. These require particular understanding of visual, tactile, safety and convenience criteria. Industrial designers combine these considerations with practical concern for technical processes and requirements for manufacture; marketing opportunities and economic constraints; and distribution, sales and servicing arrangements. Industrial designers are guided by the awareness of their obligations to protect and promote public safety and well being; to respect the environment; and to observe ethical business practices.

Graduates with a Master of Industrial Design have career opportunities in four general areas; corporate design offices in manufacturing companies, independent design consulting firms, governmental agencies and educational institutions.

Admissions Requirements: Applicants will be considered for admission on an individual basis and plans of study will be developed to take into account previous academic and professional experiences. In addition to other forms, applications must include a departmental personal data forms and a portfolio (required of students with design backgrounds).

Student Financial Support: Priority is given to students in the major science, social science and technology areas.

GRADUATE COURSES

ID 500 Advanced Industrial Design (Series).
ID 511 Industrial Design Materials and Processes I.
ID 512 Industrial Design Materials and Processes II.
ID 532 Advanced Concepts in Product Engineering.
ID 570 Advanced Industrial Design - Textiles (Series).
ID 581 Industrial Design Project Preparation.
ID 582 Special Topics in Industrial Design.
ID 588 Final Project Studio in Industrial Design.
ID 602 Special Seminar.
ID 630 Independent Study.
ID 676 Special Project.
ID 685 Master's Supervised Teaching.
ID 690 Master's Examination.

Industrial Engineering

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Industrial Engineering	Y		Y		Y	

GRADUATE FACULTY

J. R. Wilson, *Head of the Department*

Director of Graduate Programs:

S. Fang, Box 7906, 515.2192, fang@eos.ncsu.edu

University Professor: S. E. Elmaghhraby

Professors: M. A. Ayoub, R. H. Bernhard, C. T. Culbreth Jr., S. Fang, T. J. Hodgson, R. E. King, W. L. Meier Jr., H. L. Nuttle, R. G. Pearson, S. D. Roberts, J. R. Wilson, R. E. Young; ***Professors Emeriti:*** R. Alvarez, C. A. Anderson, J. R. Canada, W. A. Smith Jr.; ***Associate Professors:*** Y. Fathi, M. G. Kay, Y. Lee, G. A. Mirka, E. T. Sanii; ***Assistant Professors:*** D. R. Cormier, D. B. Kaber, C. M. Sommerich, J. B. Taylor; ***Adjunct Assistant Professors:*** S. D. Moon, J. Trevino

ASSOCIATE MEMBERS OF THE PROGRAM

Professors: X. Chao, T. Johnson; ***Adjunct Professors:*** R. Luo; ***Associate Professors:*** T. L. Honeycutt, R. D. Rodman

The graduate faculty in industrial engineering supports academic and research interests in four areas: manufacturing systems (manufacturing processes, CAM, CIM, robotics, automation, rapid prototyping and concurrent engineering); production systems (planning, scheduling, routing, inventory control, materials handling, facility design, supply chain management, furniture manufacturing and management, and quality control); systems analysis and optimization

(stochastic processes, simulation, fuzzy systems and modeling); and ergonomics (human performance, occupational safety, and biomechanics). The department faculty actively supports independent graduate degree programs in operations research and integrated manufacturing systems engineering.

Admission Requirements: Applications are accepted from undergraduate majors in engineering and in the behavioral, physical and mathematical sciences who meet prerequisites in calculus and matrix/linear algebra, computer science and statistics.

Master's Degree Requirements: The M.S. degree involves depth of study in a specified area of concentration, nine hours in a minor and six hours of research credit. The Master of Industrial Engineering (M.IE.) degree may be obtained by course work only; project work is optional. A minimum of 33 hours is required for the M.IE.

Doctoral Degree Requirements: This degree requires 72 credit hours of course and research work beyond the bachelor's degree. Undergraduate students with superior credentials may apply directly to the doctoral program and bypass the master's degree. For students who have completed the master's degree, typically 30 to 36 hours of additional course work are required. A departmental written qualifying examination in two areas is required.

Student Financial Support: Research and teaching assistantships are available on a competitive basis to early applicants. Fellowships of \$4,000 and \$8,000 which supplement assistantship stipends, are available to U.S. applicants with superior credentials. Award priority is given to Ph.D. then M.S. applicants.

GRADUATE COURSES

- IE(MA,OR) 505 Linear Programming.
- IE 510 Applied Engineering Economy.
- IE 514 Manufacturing Product Engineering.
- IE 518 Manufacturing Operations Management.
- IE 530 Advanced Furniture Manufacturing System Design.
- IE 531 Advanced Furniture Facilities Design.
- IE 543 Musculoskeletal Mechanics.
- IE 544 Occupational Biomechanics.
- IE(CSC) 546 Management Decision and Control Systems.
- IE(CSC) 556 Voice Input/Output Communication Systems.
- IE 589 Special Topics in Industrial Engineering.
- IE 601 Seminar.
- IE 610 Special Topics in Industrial Engineering.
- IE 637 Directed Study in Industrial Engineering.
- IE 639 Advanced Directed Study in Industrial Engineering.
- IE 646 Research Practicum in Occupational Biomechanics.
- IE 677 Industrial Engineering Projects.
- IE 685 Master's Supervised Teaching.
- IE 690 Master's Examination.
- IE 693 Master's Supervised Research.
- IE 695 Master's Thesis Research.
- IE 696 Summer Thesis Research.
- IE 699 Master's Thesis Preparation.
- IE 706 Design of Flexible Manufacturing Systems.
- IE 707 Real-time Control of Automated Manufacturing.
- IE(OR) 709 Dynamic Programming.
- IE 711 Capital Investment Economic Analysis.
- IE 712 Bayesian Decision Analysis for Engineers and Managers.

IE 715 Manufacturing Process Engineering.
IE 716 Automated Systems Engineering.
IE 717 Computerized Process Planning.
IE 719 CIM System Design.
IE(MAE) 720 Industrial Robotics.
IE 721 Advanced Problems in Management Systems Engineering.
IE 723 Production Planning, Scheduling and Inventory Control.
IE 725 Organizational Planning and Control.
IE 731 Multi-attribute Decision Analysis.
IE 736 Computer Integration of Manufacturing Systems.
IE(PSY) 740 Human Factors in Systems Design.
IE 741 Occupational Safety Engineering.
IE 742 Environmental Stress, Physiology and Performance.
IE(PSY) 743 Ergonomic Performance Assessment.
IE(PSY) 744 Human Information Processing.
IE(PSY) 745 Human Performance.
IE 748 Quality Engineering.
IE 749 Tolerances in Design and Manufacturing.
IE 750 Concurrent Engineering.
IE 751 Modeling Imprecision in Design and Manufacturing.
IE 753 Material Handling Systems.
IE 754 Logistics Engineering.
IE 755 The Just-in-time Production System.
IE(CSC,ECE) 756 Advances in Voice Input/Output Communications Systems.
IE 759 Constraint Modeling of Manufacturing Systems.
IE 760 Applied Stochastic Models in Industrial Engineering.
IE(OR) 761 Queues and Stochastic Service Systems.
IE(CSC,OR) 762 Computer Simulation Techniques.
IE(MA,OR) 766 Network Flows.
IE 767 Upper Extremity Biomechanics.
IE 768 Spine Biomechanics.
IE(OR) 772 Stochastic Simulation Design and Analysis.
IE 789 Advanced Special Topics in Industrial Engineering.
IE 790 Advanced Special Topics in Systems Analysis and Optimization.
IE 791 Advanced Special Topics in Manufacturing.
IE 793 Advanced Special Topics in Production.
IE 794 Advanced Problems in Ergonomics.
IE 796 Research Practicum in Occupational Biomechanics.
IE 801 Seminar.
IE(PSY) 802 Area Seminar in Ergonomics.
IE 803 Seminar in Product Safety and Liability.
IE 804 Seminar in Applied Ergonomics.
IE(MA,OR) 812 Special Topics in Mathematical Programming.
IE 815 Advanced Special Topics in Industrial Engineering.
IE 816 Advanced Special Topics in Systems Analysis and Optimization.
IE 817 Advanced Special Topics in Manufacturing.
IE 818 Advanced Special Topics in Production.
IE 837 Directed Study in Industrial Engineering.
IE 839 Advanced Directed Study in Industrial Engineering.
IE 861 Production Systems.
IE(OR) 862 Scheduling and Routing.
IE 877 Industrial Engineering Projects.
IE 885 Doctoral Supervised Teaching.
IE 890 Doctoral Preliminary Examination.
IE 893 Doctoral Supervised Research.
IE 895 Doctoral Dissertation Research.
IE 896 Summer Dissertation Research.
IE 899 Doctoral Dissertation Preparation.

Instructional Technology - Computers

For a listing of graduate faculty and program information, see curriculum and instruction.

Integrated Manufacturing Systems Engineering

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Integrated Manufacturing Systems Engineering					Y	

GRADUATE FACULTY

Director of Graduate Programs:

L. M. Silverberg, Box 7915, 515.5282, silver@eos.ncsu.edu

Burlington Industries Professor of Textile Technology: R. L. Barker

Professors: M. D. Boyette, T. G. Clapp, C. T. Culbreth Jr., P. L. Grady, T. J. Hodgson, T. Johnson, R. E. King, W. L. Meier Jr., H. L. Nuttle, W. J. Rasdorf, S. D. Roberts, J. P. Rust, K. Tai, J. R. Wilson, R. E. Young; **Adjunct Professors:** A. E. Bayoumi, R. Luo; **Professors Emeriti:** R. E. Carawan, W. A. Smith Jr., C. F. Zorowski; **Associate Professors:** D. R. Bahler, P. Banks-Lee, Y. A. Chen, Y. Fathi, T. K. Ghosh, G. L. Hodge, W. J. Jasper, M. G. Kay, J. W. Leach, Y. Lee, G. A. Mirka, M. K. Ramasubramanian, P. I. H. Ro, R. D. Rodman, E. T. Sanii, A. M. Seyam; **Adjunct Associate Professors:** J. Taheri; **Assistant Professors:** D. R. Cormier, C. M. Somerich, J. B. Taylor; **Visiting Assistant Professors:** J. J. Shin; **Adjunct Assistant Professors:** J. A. Janet, J. C. Sutton III, J. Trevino

ASSOCIATE MEMBERS OF THE PROGRAM

Adjunct Associate Professors: R. S. Gyuresik

The Integrated Manufacturing Systems Engineering Institute (IMSEI), established in 1984, provides multidisciplinary graduate- level education and practical training opportunities in the theory and practice of integrated manufacturing systems engineering at the master's degree level. IMSEI focuses on providing a manufacturing presence and a program environment in the College of Engineering where faculty, graduate students and industry can engage cooperatively in multidisciplinary graduate education, basic and applied research, and technology transfer in areas of common interest related to modern manufacturing systems technology. The objective of the IMSEI program is to take a student with traditional discipline background in engineering or the physical sciences and broaden the student's understanding of the multidisciplinary area of manufacturing systems. Particular emphasis is placed on computer integration and application in manufacturing.

Admission Requirements: Admission to the IMSEI master's program requires a B.S. degree from an accredited institution preferably in engineering or in physics, mathematics or computer science.

Master's Degree Requirements: This degree requires a minimum of 27 hours of graduate course work and six hours of research project. Five core courses, required of all students, present a multidisciplinary overview of subject materials basic to manufacturing systems. Specialization is provided in the student's plan of graduate work through the selection of a minimum of four electives in a specified area of concentration. The six hours of required individual or team research project are intended to complement and reinforce the area of concentration.

Student Financial Support: Assistantships, fellowships and internships are available to qualified students. Full financial support package includes payments for tuition and fees and health insurance coverage.

Fellowship/Internship: The IMSEI internship program has been established to provide a cooperative industrial and academic experience for some IMSEI students and industrial sponsors. Several Fellowship/Internships awards are made available every year for special training in IMSEI member companies. Students who are selected to participate in the internship program will receive financial support for four semesters and one summer. Typically, the student will attend classes for two semesters (fall and spring), work at the sponsor company for the following summer and fall semester, and complete the IMSEI program the following spring semester. The student will use some aspect of the experience at the sponsor company as the basis of the required IMSEI project.

Other Relevant Information: The Institute is supported by an industrial affiliates group of member companies. They have included AT&T, CP&L, Dupont, Ford Motor, GE, IBM, John Deere, Nortel, R. J. Reynolds Tobacco and Westinghouse. The Institute interacts with member companies through an Industry Advisory Board and a Technical Monitors Group.

Core Courses (1 required from each category for a total of 15 credit hours required)

Category 1:

CSC 510 Software Engineering
CSC 742 Database Management
IE(CSC) 762 Computer Simulation Techniques

Category 2:

IE 711 Capital Investment Economic Analysis
BUS 521 Managerial Finance

Category 3:

IE 716 Computer-aided Manufacturing
Or
IE 714 Product Engineering
And
IE 715 Precision Manufacturing

Category 4:

IE 723 Production Planning, Scheduling and Inventory Control

Category 5:

MAE 742, Mechanical Design for Automated Assembly

GRADUATE COURSES

IMS 675 Manufacturing Systems Engineering Project.

IMS 680 Master's Directed Study.

IMS 685 Master's Supervised Teaching.

IMS 690 Master's Examination.

International Studies

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
International Studies					Y	

GRADUATE FACULTY

Director of Graduate Programs:

M. S. Soroos, Box 8102, 515.3755, soroos@ncsu.edu

Graduate Alumni Distinguished Professor: M. D. Schulman

William Neal Reynolds Professor: S. W. Buol

Professors: L. S. Bull, C. H. Carlton, F. W. Cubbage, D. M. Daley, E. W. Erickson, R. L. Moxley, J. K. Ocko, R. P. Patterson, J. C. H. Shih, F. J. Smith, M. S. Soroos, M. A. Witt Frese; **Professors Emeriti:** H. D. Gross; **Associate Professors:** J. C. Dutton Jr., C. E. Griffin, R. C. Kochersberger Jr., A. W. N. Mitchell, R. S. Moog, S. R. Raval, M. A. Renkow, A. L. Schiller, R. J. Thomson, J. M. Wallace III; **Assistant Professors:** W. A. Boettcher III, M. A. Johnson, R. F. Stephen, S. T. Warren

The Master of International Studies (MIS), formerly the Master of Technology for International Development, is a 36-hour, non-thesis program which prepares students for careers in government service, international institutions, international businesses and nongovernmental organizations. While the degree is administered by the Department of Political Science and Public Administration, the MIS is a multidisciplinary degree program with a faculty and curriculum which spans numerous colleges and several departments. Approximately half of the course work for the degree is devoted to developing international knowledge and competencies. The remaining half is taken up largely by individualized regional, topical, professional or technical specializations designed by students in consultation with their faculty advisors.

Admission Requirements: Applicants must provide GRE scores in addition to other application materials required by the Graduate School.

Degree Requirements: The requirements for the MIS degree are as follows:

1. 36 credit hours or course work;

2. One course from each of the following groupings:

Group A - International Relations

PS 530 Seminar in International Relations
PS 533 Global Problems and Policies
HI 554 History of U.S. Foreign Relations

Group B - Comparative Politics/Societies

PS 540 Seminar in Comparative Politics
PS 545 Comparative Systems of Law and Justice
SOC 726 Developing Societies
SOC 727 Comparative Societies

Group C - International Law and Organization

PS 531 International Law and Organization
PS 536 Global Environmental Law and Policy

Group D - International Economy/Development

BUS 426 International Financial Management
EC 448 International Economics
ECG 540 Economic Development
PS 539 International Political Economy

Group E - Cross-cultural Communication

BUS 502 Global and Cultural Environment in Management
COM 462 Cross-cultural Communication
PSY 755 Cross-cultural Research and Development

3. An individualized specialization of 12-15 hours. The specialization may be in a geographical region (e.g., Europe), an international topic (e.g., environment and sustainable development), a professional field (e.g., public administration) or a technical specialty (e.g., agriculture). The specialization should include an appropriate research methodology course, if recommended by the chair of the student's faculty advisory;

4. Capstone writing seminar (three hours);
5. A significant foreign work or study experience of at least twelve weeks;
6. Reading/listening/speaking competency in a foreign language;
7. A comprehensive oral examination.

GRADUATE COURSES

MIS 501 Colloquium in International Development.
MIS 598 Topical Problems in International Development
MIS 630 Independent Study.
MIS 651 Internship in International Development.
MIS 685 Master's Supervised Teaching
MIS 690 Master's Examination.

Landscape Architecture

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Landscape Architecture					Y	

GRADUATE FACULTY

A. B. Stein, *Head of the Department*

Director of Graduate Programs:

A. B. Stein, Box 7701, 515.8342, achva_stein@ncsu.edu

Professors: A. R. Abbate, R. C. Moore, A. R. Rice, A. B. Stein, R. R. Wilkinson; **Associate Professors:** F. H. Magallanes, S. R. Raval; **Research Associate Professors:** J. D. Tomlinson, N. M. White; **Assistant Professors:** M. E. Myers

ASSOCIATE MEMBERS OF THE PROGRAM

Professors: H. A. Devine, W. E. Hooker; **Lecturers:** M. E. E. Traer

Course offerings or research facilities are available in the following areas: site planning and design, urban public spaces, community design, regional design, resource management and specialized landscapes.

Admission Requirements: The best-qualified applicants will be accepted up to the number of spaces that are available for new students. Exceptions to the minimum 3.00 GPA may be made for students with special backgrounds, abilities and interests.

Master's Degree Requirements: I. Accredited First Professional Degree in Landscape Architecture: Candidates follow a 72-hour sequence of courses over a six-semester period. Three semesters of the program of study are determined by the required curriculum. The last three semesters of study are outlined by the student, Director of Graduate Programs and/or advisor. A final project with an investigative direction is set in collaboration with a committee of faculty. A formal presentation of findings to the faculty, student body and local professionals is required. The summary report must be submitted to the School of Design faculty to meet the graduation requirements. II. Advanced Studies in Landscape Architecture: Candidates with an accredited undergraduate degree follow a 48-hour sequence of courses. Twenty-seven hours of electives are chosen through advising with the Director of Graduate Programs, advisors and faculty committee. Similar requirements for a final project, presentation and summary report apply.

Other Relevant Information: Students have the option of including a graduate minor in their course of studies. Minors can be in any other graduate program offered at NC State. Some examples of graduate minors are: architecture, education, horticultural science, civil engineering, and parks, recreation and tourism management. Special programs and labs in the Department of

Landscape Architecture and the College of Design include the Center for Universal Design and the Design Research Laboratory and in international courses and design studios in Italy, India and Spain.

GRADUATE COURSES

LAR 500 Landscape Design Studio.
LAR 510 Graphics for Landscape Architects.
LAR 511 Community Design Policy.
LAR 512 Landscape Resource Management.
LAR 513 Social Factors Analysis in Site Planning.
LAR 515 Advanced Community Design and Development Control.
LAR 521 Values, Theory and Methods of Landscape Architecture.
LAR 530 Advanced Site Planning.
LAR 533 Plants and Design.
LAR 551 Ethics of Professional Practice in Landscape Architecture.
LAR 564 Management and Marketing Techniques in Community Design.
LAR 565 International Landscape Architecture Design Studio.
LAR 573 Historic Preservation.
LAR 574 Landscape and Townscape Conservation.
LAR 575 Development Planning.
LAR 576/ARC 576/DDN 776 Community Design.
LAR 577/ARC 577/DDN 777 Sustainable Communities.
LAR 578/DDN 778 Ecological Design.
LAR 579/DDN 779 Human Use of the Urban Landscape.
LAR 582 Special Topics in Landscape Architecture.
LAR 630 Independent Study.
LAR 679 Final Studio Project.
LAR 685 Master's Supervised Teaching.
LAR 690 Master's Examination.
LAR 697 Final Research Project.

Liberal Studies

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Liberal Studies				Y		

GRADUATE FACULTY

Director of Graduate Programs:

C. D. Korte, Box 7107, 515.7965, korte@social.chass.ncsu.edu

Professors: E. W. Erickson, D. B. Greene, C. D. Korte, R. P. Patterson, J. T. Pennell, P. N. Reid,

J. M. Riddle, M. S. Soroos, J. W. Wilson; **Professors Emeriti:** A. C. Barefoot Jr., A. S. Knowles;

Associate Professors: P. W. Hamlett, F. W. Hayes III, R. L. Hoffman, M. Javidi, R. A. Waschka

II; **Visiting Associate Professors:** C. V. Brown; **Assistant Professors:** D. H. Crumbley, J. R.

Herkert, S. T. Warren; **Visiting Assistant Professors:** L. L. Spence

ASSOCIATE MEMBERS OF THE PROGRAM

Visiting Assistant Professors: J. C. Bonham

The Master of Arts in Liberal Studies (MALS) program is an interdisciplinary graduate program which is administered by the Division of Multidisciplinary Studies and offered by the College of Humanities and Social Sciences. This is a broad, interdisciplinary program of part-time graduate study that integrates and expands awareness and that is geared to the student's personal interests. Each student, in consultation with an academic advisor, designs an individual program of study around an interdisciplinary theme or topic that is of intrinsic interest to the student or that relates to the student's professional or vocational interests. Students take graduate courses across a range of NC State departments as well as MALS seminars designed specifically for the program.

Admissions Requirements: Students entering the master's program in liberal studies must have an undergraduate degree. In addition to the material required by the Graduate School, students applying are asked to submit a statement describing their objectives in doing a degree in liberal studies and a writing sample. GRE scores are not required. All applicants are interviewed.

Master's Degree Requirements: Thirty hours of course work made up of (1) a minimum of three MALS seminars, (2) eighteen hours representing the student's interdisciplinary theme or concentration, and (3) a three-hour culminating project. Examples of concentrations that are well supported by graduate courses in the NC State curriculum are: science, technology and society, the American experience and leadership

GRADUATE COURSES

MDS 595 Special Topics in Multidisciplinary Studies.

MDS 610 Special Topics.

MDS 685 Master's Supervised Teaching.

MLS 501 Seminar in Liberal Studies.

MLS 630 Independent Study.

MLS 676 Independent Project.

MLS 690 Master's Examination.

Management

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Management			Y			

GRADUATE FACULTY

Director of Graduate Programs:

S. G. Allen, Box 7229, 515.5584, steve_allen@ncsu.edu

Bank of America University Distinguished Professor: R. B. Handfield

Distinguished University Professor: M. A. Rappa

Professors: S. G. Allen, S. H. Barr, R. P. Burns Jr., R. L. Clark, G. W. Dickson, D. M. Holthausen Jr., C. P. Jones, S. E. Margolis, J. W. Wilson; **Professors Emeriti:** J. R. Canada, R. J. Lewis;

Associate Professors: D. L. Baumer, C. C. Bozarth, S. N. Chapman, Y. A. Chen, J. C. Dutton Jr., E. A. McDermed, K. Mitchell, A. Padilla, J. C. Poindexter Jr.; **Visiting Associate Professors:** J. D. Powell; **Associate Professors Emeriti:** C. W. Harrell Jr.; **Assistant Professors:** L. Aiman-Smith, K. S. Davis, J. B. Earp, S. K. Markham, J. K. McCreery, M. Montoya-Weiss, P. W. Mulvey, D. P. Pagach, F. C. Payton, B. B. Tyler, G. B. Voss, G. S. Young

Since its inception in 1976, the Master of Science in Management (MSM) program has taken a distinctive, innovative approach to management education. The MSM focuses on aspects of management that have traditionally been neglected in business schools, especially the management of information, production and technology.

A distinctive aspect of the MSM program is the integration of advanced courses in technology and management-related topics in other colleges at NC State into its curriculum. MSM students take courses in industrial engineering, statistics, computer science and natural resources to give them skills and knowledge not generally available in most business schools. In addition, many students in other colleges at NC State take minors in management.

MSM Curriculum: The MSM curriculum requires that every student complete the core curriculum listed below, along with courses in a technical concentration, for a total of 42 credit hours.

Required courses:

ACC 580 Survey of Accounting
BUS 500 Strategic Management
BUS 520 Managerial Finance
BUS 530 Managing People in the High Tech Environment
BUS 560 Marketing Management and Strategy
BUS 570 Production and Operations Management
ECG 507 Economics for Managers

Technical Concentration: Minimum of 12 hours of courses in one of the following areas: electronic commerce, information technology management, operations or supply chain management, new product development, technology commercialization and financial management.

Electives: Minimum of 9 hours, 3 hours of which must be in a course in information technology management.

Admission Requirements: Students must have previous courses in calculus, principles of economics (micro and macro) and statistics, as well as knowledge of personal computers including word processing and spreadsheet software. In addition to basic Graduate School admission requirements, applicants must submit recent GMAT scores. Admission decisions are based on academic performance and potential, GMAT scores, the applicant's essay indicating how the

MSM degree will further his/her career and work experience, where appropriate. For further information, there is an MSM home page that can be accessed off the home page of the College of Management.

Other Relevant Information: Day and evening courses are available; students can attend on either a part- or full-time basis.

Minor in Management: Students enrolled in master's and doctoral programs can complete the minor by taking courses that meet requirements for the MSM degree. Master's students must take nine hours; doctoral students must take 15 hours.

GRADUATE COURSES

- BUS 500 Strategic Management.
- BUS 501 Legal and Regulatory Environment in Management.
- BUS 504 Technology, Law and the Internet.
- BUS 510 Managing the Digital Enterprise.
- BUS 511 Networking Infrastructure for E-commerce.
- BUS 520 Managerial Finance.
- BUS 522 Portfolio and Capital Market Theory.
- BUS 524 Financial Markets and Institutions.
- BUS 526 International Finance.
- BUS 527 Corporate Risk Management with Derivatives.
- BUS 528 Short-term Capital Management.
- BUS 529 New Firm Financing.
- BUS 530 Managing People in the High-Tech Environment.
- BUS 532 Strategic Human Resource Management
- BUS 533 Leadership in Management.
- BUS 540 Information Technology for Managers.
- BUS 541 Strategic Information Technology.
- BUS 543 DataBase Management.
- BUS 545 Management Support Systems.
- BUS 546 Analysis and Design of Management Support Systems
- BUS 547 Management Support Systems Project.
- BUS 549 Managerial Issues in Information Systems.
- BUS 550 Data Analysis and Forecasting Methods for Management.
- BUS 560 Marketing Management and Strategy.
- BUS 562 Research Methods in Marketing.
- BUS 564 Project Management.
- BUS 565 Product Design and Development.
- BUS 570 Production and Operations Management.
- BUS 572 Planning and Control Systems.
- BUS 573 Supply Chain Management.
- BUS 574 Management of Technology.
- BUS(MAT) 576 Technology Evaluation and Commercialization Concepts.
- BUS(MAT) 577 High Technology Entrepreneurship.
- BUS(MAT) 578 Implementing Technology Commercialization Strategies.
- BUS 579 Entrepreneurship
- BUS(TTM) 585 Market Research in Textiles.
- BUS 590 Special Topics in Business Management.
- BUS 630 Independent Study.

Marine, Earth, and Atmospheric Sciences

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Marine, Earth and Atmospheric Sciences	Y		Y			

GRADUATE FACULTY

R. R. Patty, *Head of the Department*

Director of Graduate Programs:

G. S. Janowitz, Box 8208, 515.7837, janowitz@ncsu.edu

Scholar in Residence: R. R. Braham

Professors: S. P. S. Arya, N. E. Blair, V. V. Cavaroc Jr., J. M. Davis, D. J. DeMaster, R. V. Fodor, G. S. Janowitz, D. Kamykowski, Y. Lin, J. M. Morrison, L. J. Pietrafesa, S. Raman, V. K. Saxena, T. G. Wolcott; **Research Professors:** V. P. Aneja, D. A. Russell; **Visiting Professors:** T. F. Clark, T. S. Hopkins, H. G. Reichle Jr.; **Adjunct Professors:** S. W. Chang, J. J. DeLuisi, A. H. Hines, R. V. Madala, J. M. Pelissier, S. R. Riggs, W. H. Snyder, M. L. Strobel; **Professors Emeriti:** H. S. Brown, L. J. Langfelder, C. J. Leith, W. J. Saucier, C. W. Welby; **Associate Professors:** D. B. Eggleston, D. P. Genereux, J. P. Hibbard, M. M. Kimberley, C. E. Knowles, S. E. Koch, E. L. Leithold, A. J. Riordan, F. H. M. Semazzi, P. Shaw, W. J. Showers, E. F. Stoddard, G. F. Watson, D. L. R. Wolcott; **Visiting Associate Professors:** M. L. Kaplan; **Adjunct Associate Professors:** D. Byun, V. S. Connors, C. A. Davis, D. G. Evans, R. Mathur, R. W. Wiener; **Assistant Professors:** T. G. Drake, G. M. Lackmann, S. W. Snyder, L. Xie; **Research Assistant Professors:** D. S. Niyogi; **Visiting Assistant Professors:** R. E. Barrick, J. J. Charney; **Adjunct Assistant Professors:** K. V. Alapaty, J. S. Burke, D. M. Checkley Jr., A. F. Hanna, G. J. Kirkpatrick, A. J. Lewitus, S. W. Ross; **Interinstitutional Faculty:** L. B. Cahoon, D. G. Lindquist, J. F. Parnell, J. R. Pawlik, M. H. Posey, R. D. Roer

ASSOCIATE MEMBERS OF THE PROGRAM

Professors: B. J. Copeland, J. M. Miller; **Associate Professors:** J. M. Burkholder; **Visiting Assistant Professors:** L. L. Spence

Graduate disciplines in atmospheric science, geology and marine sciences are offered. Within marine sciences the subdisciplines of biological, chemical, geological and physical oceanography are recognized by the profession.

Admission Requirements: An bachelor's degree with research experience or a master's degree is required for entry into the Ph.D. program. The GRE Subject Test scores are required only for applicants in biological oceanography. A bachelor's degree in a science, mathematics or engineering is required for entry into the M.S. program in atmospheric science, geology, and biological, chemical, geological or physical oceanography. Undergraduate field camp is required

of all students in the M.S. program in geology; this requirement may be fulfilled before or after admission. An M.S. degree with a non-thesis option for students on leave for a fixed period from government positions is available and admission to this option must be requested at the time of application.

Master's Degree Requirements: Specific course requirements are determined by the advisory committee of each student. However, MEA 601 Seminar is required of all M.S. students no later than the third semester in residence. Marine science students are required to take core courses in two of the three subdisciplines other than their own.

Doctoral Degree Requirements: Specific courses are determined by the student's advisory committee. Registration in seminar, MEA 801, is required of all Ph.D. students no later than the fourth semester in residence. Marine science students are required to take core courses in all three subdisciplines other than their own; this requirement may be fulfilled at the M.S. level.

Student Financial Support: Research and teaching assistantships are available.

Other Relevant Information: Students are assigned initial advisors upon admission. It is the student's responsibility to secure the consent of a faculty member to serve as the permanent advisor who will chair or co-chair the advisory committee.

GRADUATE COURSES IN COMMON TO ALL MEA STUDENTS

MEA 601 Seminar.
MEA 685 Master's Supervised Teaching.
MEA 690 Master's Examination.
MEA 693 Master's Supervised Research.
MEA 695 Master's Thesis Research.
MEA 696 Summer Thesis Research.
MEA 699 Master's Thesis Preparation.
MEA 801 Seminar.
MEA 885 Doctoral Supervised Teaching.
MEA 890 Doctoral Preliminary Examination.
MEA 893 Doctoral Supervised Research.
MEA 895 Doctoral Dissertation Research.
MEA 896 Summer Dissertation Research.
MEA 899 Doctoral Dissertation Preparation.

GRADUATE COURSES

Atmospheric Science
MEA 510 Air Pollution Meteorology.
MEA 512 Satellite Meteorology.
MEA 513 Radar Meteorology.
MEA 514 Advanced Physical Meteorology.
MEA 593 Special Topics in Atmospheric Science.
MEA 613 Special Topics in Atmospheric Science.
MEA 700 Environmental Fluid Mechanics.
MEA 702 Advanced Cloud and Precipitation Physics.
MEA 703 Atmospheric Aerosols.
MEA 705 Dynamic Meteorology.
MEA 706 Meteorology of the Biosphere.
MEA 707 Planetary Boundary Layer
MEA 708 Atmospheric Turbulence.
MEA 710 Atmospheric Dispersion.

MEA 712 Mesoscale Modeling.
MEA 713 Mesoscale Dynamics.
MEA 714 Atmospheric Convection.
MEA 715 Dynamics of Mesoscale Precipitation System.
MEA 716 Numerical Weather Prediction.
MEA 717 Advanced Weather Analysis.
MEA 719 Climate Modeling.
MEA 720 Coastal Meteorology.
MEA 721 Air-Sea Interaction.
MEA(MAE) 725 Geophysical Fluid Mechanics.
MEA(MAE) 726 Advanced Geophysical Fluid Mechanics.
MEA(CE) 779 Advanced Air Quality.
MEA 793 Advanced Special Topics in Atmospheric Science.
MEA 813 Special Topics in Atmospheric Science.

Earth Science

MEA 570 Geological Oceanography.
MEA 574 Advanced Igneous Petrology.
MEA 575 Advanced Metamorphic Petrology.
MEA 576 Applied Sedimentary Analysis.
MEA 577 Electron Microprobe Analysis of Geologic Material.
MEA 578 Depositional Environments and Lithostratigraphy.
MEA 585 Hydrogeology.
MEA 592 Special Topics in Earth Science.
MEA 599 Regional Geology of North America.
MEA 612 Special Topics in Earth Science.
MEA 758 Laboratory and Field Methods for Investigation of the Seabed.
MEA 759 Organic Geochemistry.
MEA 760 Biogeochemistry.
MEA 763 Geochemistry.
MEA 764 Sedimentary Geochemistry.
MEA 785 Hydrogeology of Groundwater Pollution and Protection.
MEA 788 Advanced Structural Geology.
MEA 789 Topics in Appalachian Geology.
MEA 790 Geotectonics.
MEA 792 Advanced Special Topics in Earth Science.
MEA 794 Regional Tectonics.
MEA 795 Photogeology and Remote Sensing.
MEA 796 Exploration and Engineering Geophysics.
MEA 812 Special Topics in Earth Science.

Marine Science

MEA 540 Principles of Physical Oceanography.
MEA(ZO) 550 Principles of Biological Oceanography.
MEA 551 Marine Physical-Biological Interactions.
MEA 560 Principles of Chemical Oceanography.
MEA 562 Marine Sediment Transport.
MEA 570 Geological Oceanography.
MEA 591 Special Topics in Marine Science.
MEA 611 Special Topics in Marine Science.
MEA 615 Graduate At-Sea Laboratory.
MEA 700 Environmental Fluid Mechanics.
MEA 713 Mesoscale Wave Dynamics.
MEA 721 Air-Sea Interaction.
MEA(MAE) 725 Geophysical Fluid Mechanics.
MEA(MAE) 726 Advanced Geophysical Fluid Mechanics.
MEA 735 Fourier Analysis of Geophysical Data.
MEA 741 Synoptic Physical Oceanography.
MEA(CE) 742 Gravity Wave Theory I.
MEA 743 Ocean Circulation.
MEA 744 Dynamics of Shelf Circulation.
MEA 745 the Physical Dynamics of Estuaries.

MEA (ZO) 750 Marine Benthic Ecology.
MEA 752 Marine Plankton Ecology.
MEA(ZO) 754 Advances in Marine Community Ecology.
MEA(ZO) 756 Ecology of Fishes.
MEA 758 Laboratory and Field Methods for Investigation of the Seabed.
MEA 759 Organic Geochemistry.
MEA 760 Biogeochemistry.
MEA 762 Marine Geochemistry.
MEA 767 Continental Margin Sedimentation.
MEA(MAE) 768, 769 Perturbation Method in Fluid Mechanics I, II.
MEA 791 Advanced Special Topics in Marine Science.
MEA 811 Special Topics in Marine Science.

Materials Science and Engineering

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Materials Science and Engineering	Y		Y		Y	

GRADUATE FACULTY

J. M. Rigsbee, *Head of the Department*

Director of Graduate Programs:

R. O. Scattergood, Box 7907, 515.7843, ron_scattergood@ncsu.edu

Distinguished Research Professor: J. J. Cuomo

Distinguished University Research Professor: J. Narayan

Kobe Steel Distinguished University Professor: R. F. Davis

Professors: K. J. Bachmann, R. B. Benson Jr., N. A. El-Masry, J. J. Hren, A. I. Kingon, C. C. Koch, K. L. Murty, J. M. Rigsbee, G. A. Rozgonyi, P. E. Russell, R. O. Scattergood; *Research Professors:* D. M. Maher; *Adjunct Professors:* O. H. Auciello, G. L. Doll, J. T. Glass, F. Shimura; *Professors Emeriti:* W. W. Austin Jr., H. Conrad, A. Fahmy, J. K. Magor, K. L. Moazed, H. Palmour III, H. H. Stadelmaier, R. F. Stoops; *Associate Professors:* C. M. Balik, D. W. Brenner, J. Kasichainula, Z. Sitar; *Visiting Associate Professors:* D. P. Griffis; *Adjunct Associate Professors:* J. T. Prater; *Associate Professors Emeriti:* J. V. Hamme; *Research Assistant Professors:* J. Maria; *Adjunct Assistant Professors:* S. D. Smith

ASSOCIATE MEMBERS OF THE PROGRAM

Professors: S. M. Bedair, G. Lucovsky, D. E. Aspnes, J. A. Bailey, R. J. Nemanich; **Associate Professors:** H. H. Lamb, G. N. Parsons

Materials and materials limitations pervade all of the engineering and high technology fields that are an integral part of our society. Graduate programs in this department focus on understanding the structure, structure modification and properties of materials and the development of new or improved materials and advanced processing methods which are critical links between the design and the realization of new systems.

Admission Requirements: In addition to the general admission requirements as set by the Graduate School, the department requires submission of GRE scores or convincing evidence of the competence of the applicant and his/her ability to satisfy the requirements for the graduate degree for which he/she is seeking admission. Non-native English speakers also require a minimum TOEFL score of 575.

Master's Degrees Requirements: The minimum requirements for the Master of Materials Science and Engineering degree are 33 credit hours. The M.S. degree has the minimum requirement of 30 credit hours including six credit hours for research.

Doctoral Degree Requirements: The minimum requirements for the doctoral degree are 72 credit hours including 21 to 25 credit hours for research, two to six hours of the teaching course, a minimum of nine credit hours at or above the 720 level, excluding research credit, and 12 credit hours in one or more supporting fields of which no more than three credit hours may be at the 400 level.

Student Financial Support: In recent years most students in the graduate program have received financial support in the form of research or teaching assistantships or fellowships.

Other Relevant Information: The department reflects the interdisciplinary nature of the field of materials science and engineering. A substantial number of current graduate students majored in fields other than but related to materials, and the department has a significant number of associated graduate faculty from other departments supervising thesis and dissertation research.

FOR GRADUATES AND ADVANCED UNDERGRADUATES

MAT 500 Modern Concepts in Materials Science.

MAT(NE) 509 Nuclear Materials.

MAT 531 Physical Metallurgy I.

MAT 540 Processing of Metallic Materials.

MAT 545 Ceramic Processing.

MAT 556 Composite Materials.

MAT 560 Microelectronic Materials Science and Technology.

MAT(TC) 561 Organic Chemistry of Polymers.

MAT 575 Polymer Technology and Engineering.

MAT(BUS) 576 Technology Evaluation and Commercialization Concepts.

MAT(BUS) 577 High Technology Entrepreneurship.

MAT(BUS) 578 Implementing Technology Commercialization Strategies.

MAT 601 Seminar.

MAT 685 Master's Supervised Teaching.

MAT 690 Master's Examination.

MAT 693 Master's Supervised Research.
 MAT 695 Master's Thesis Research.
 MAT 696 Summer Thesis Research.
 MAT 699 Master's Thesis Preparation.
 MAT 701 Diffusion and Mass Transport Processes in Solids.
 MAT 702 Defects in Solids.
 MAT 704 Electrical, Optical and Magnetic Properties of Materials.
 MAT 705 Mechanical Behavior of Engineering Materials.
 MAT 706 Phase Transformations and Kinetics.
 MAT(CH) 707 Chemical Concepts in Materials Science and Engineering.
 MAT 708 Thermodynamics of Materials.
 MAT 710 Elements of Crystallography and Diffraction.
 MAT 711 Stereology and Image Analysis.
 MAT 712 Scanning Electron Microscopy.
 MAT 715 Transmission Electron Microscopy.
 MAT 720 Advanced Crystallography and Diffraction.
 MAT 721 Theory and Structure of Amorphous Materials.
 MAT 722 Advanced Scanning Electron Microscopy and Surface Analysis.
 MAT 723 Theory and Structure of Metallic Materials.
 MAT(MAE) 731 Materials Processing by Deformation.
 MAT(MAE) 732 Fundamentals of Metal Machining Theory.
 MAT 733 Advanced Ceramic Engineering Design
 MAT 741 Principles of Corrosion.
 MAT 751 Thin Film and Coating Science and Technology I.
 MAT 752 Thin Film and Coating Science and Technology II.
 MAT 753 Advanced Mechanical Properties of Materials.
 MAT(CHE) 761 Polymer Blends and Alloys.
 MAT(TC) 762 Physical Chemistry of High Polymers - Bulk Properties.
 MAT 770 Defects, Diffusion and Ion Implantation in Semi-conductors.
 MAT(CH,TC) 772 Physical Chemistry of High Polymers - Solution Properties.
 MAT(NE) 773 Computer Experiments in Materials and Nuclear Engineering.
 MAT 775 Structure of Semicrystalline Polymers.
 MAT 791, 792 Advanced Topics in Materials Science and Engineering.
 MAT 795 Advanced Materials Experiments.
 MAT 801 Seminar.
 MAT 885 Doctoral Supervised Teaching.
 MAT 890 Doctoral Preliminary Examination.
 MAT 893 Doctoral Supervised Research.
 MAT 895 Doctoral Dissertation Research.
 MAT 896 Summer Dissertation Research.
 MAT 899 Doctoral Dissertation Preparation.

Mathematics

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Applied Mathematics	Y		Y			
Mathematics	Y		Y			

GRADUATE FACULTY

E. E. Burniston, *Head of the Department*

Director of Graduate Programs:

J. C. Dunn, Box 8205, 515.7891, joe_dunn@ncsu.edu

University Professor and Drexel Professor: H. T. Banks

Professors: E. E. Burniston, S. L. Campbell, R. E. Chandler, M. T. Chu, E. N. Chukwu, L. O. Chung, J. D. Cohen, J. M. Danby, J. C. Dunn, A. C. Fauntleroy, J. E. Franke, R. O. Fulp, R. E. Hartwig, I. Ipsen, K. Ito, E. L. Kaltofen, C. T. Kelley, K. Koh, X. Lin, J. Luh, J. A. Marlin, R. H. Martin Jr., C. D. Meyer Jr., K. C. Misra, C. Pao, E. L. Peterson, M. S. Putcha, S. Schechter, J. F. Selgrade, M. Shearer, C. E. Siewert, J. W. Silverstein, M. F. Singer, E. L. Stitzinger, R. E. White; **Adjunct Professors:** P. M. Schlosser; **Professors Emeriti:** J. W. Bishir, R. C. Bullock, W. J. Harrington, J. Levine, L. B. Martin Jr., P. A. Nickel, H. V. Park, R. A. Struble; **Associate Professors:** G. D. Faulkner, J. M. Fouque, D. E. Garoutte, P. A. Gremaud, A. G. Helminck, P. Hitczenko, H. Hong, N. Jing, A. Kheyfets, T. J. Lada, L. K. Norris, L. B. Page, S. O. Paur, R. T. Ramsay, J. Rodriguez, J. S. Scroggs, R. Silber, R. C. Smith, H. T. Tran, S. V. Tsynkov; **Associate Professors Emeriti:** D. F. Ullrich; **Assistant Professors:** H. J. Charlton, Z. Li, W. M. McEneaney, W. Wang; **Research Assistant Professors:** M. A. Haider; **Assistant Professors Emeriti:** D. J. Hansen

ASSOCIATE MEMBERS OF THE PROGRAM

Professors: L. V. Stiff; **Assistant Professors:** J. D. Brown, S. R. Lubkin

The Department of Mathematics offers programs leading to the degrees of Master of Science and Doctor of Philosophy in mathematics and in applied mathematics. Students may opt for the concentration in computational mathematics, which is attached to the program in applied mathematics. Through the Center for Research in Scientific Computation, which is housed in the Department of Mathematics, students may participate in the industrial applied mathematics program, a program of joint research endeavors with industrial and governmental partners.

Admissions Requirements: Applicants for admission should have an undergraduate or master's degree in mathematics or the equivalent. This should include courses in advanced calculus, modern algebra and linear algebra. Applicants with degrees in other subjects may be admitted but may be required to take certain undergraduate courses in mathematics without receiving graduate credit. It is recommended that applicants take the GRE Advanced Test in Mathematics.

Master of Science Requirements: In addition to course requirements, the M.S. degree requires a written master's project for 3 hours credit.

Ph.D. Requirements: A student will typically take 50-60 semester hours of course credits for the Ph.D. These courses include one semester of modern algebra and one semester of mathematical analysis. The written preliminary examination consists of examinations in three selected areas of mathematics. Prior to taking the preliminary oral examination, the student must demonstrate a working knowledge of a foreign language. The research dissertation should represent a substantial contribution to an area of mathematics or its applications.

Student Financial Support: Teaching assistantships and some research assistantships are available. Teaching assistants benefit from a structured program of training in university-level teaching.

Other Information: The Department of Mathematics has more than twenty workstations devoted exclusively to its graduate students. Students also have access to the high-performance computing and visualization equipment at the North Carolina Supercomputer Center.

GRADUATE COURSES

- MA 501 Advanced Mathematics for Engineers and Scientists I.
- MA 502 Advanced Mathematics for Engineers and Scientists II.
- MA(OR) 504 Introduction to Mathematical Programming.
- MA(E,OR) 505 Linear Programming.
- MA 507 Analysis for Secondary Teachers.
- MA 508 Geometry for Secondary Teachers.
- MA 509 Abstract Algebra for Secondary Teachers.
- MA 510 Selected Topics in Mathematics for Secondary Teachers.
- MA 511 Advanced Calculus I.
- MA 512 Advanced Calculus II.
- MA 513 Introduction to Complex Variables.
- MA 515 Analysis I
- MA 518 A First Course in Differential Geometry.
- MA 520 Linear Algebra.
- MA 521 Abstract Algebra I.
- MA 522 Computer Algebra.
- MA 523 Linear Transformations and Matrix Theory.
- MA(E,OR) 531 Dynamic Systems and Multivariable Control I.
- MA 532 Ordinary Differential Equations I.
- MA 534 Introduction to Partial Differential Equations.
- MA 535 Stability and Time Optimal Control of Hereditary Systems I.
- MA 537 Nonlinear Dynamics and Chaos.
- MA 544 Computer Experiments in Mathematical Probability.
- MA(ST) 546 Theory of Probability I.
- MA 551 Introduction to Topology.
- MA 555 Introduction to Manifold Theory.
- MA 561 Set Theory and Foundations of Mathematics.
- MA(CSC,OR) 565 Graph Theory.
- MA(BMA) 573 Mathematical and Experimental Modeling of Physical Processes I.
- MA 574 Mathematical and Experimental Modeling of Physical Processes II.
- MA(PY) 575 Mathematical Introduction to Celestial Mechanics.
- MA(PY) 576 Orbital Mechanics.
- MA(CSC) 580 Numerical Analysis I.
- MA 584 Numerical Solution of Partial Differential Equations - Finite Difference Methods.
- MA 587 Numerical Solution of Partial Differential Equations - Finite Element Method.
- MA 591 Special Topics.
- MA 676 Master's Project.
- MA 685 Master's Supervised Teaching.
- MA 690 Master's Examination.
- MA 693 Master's Supervised Research.
- MA 695 Master's Thesis Research.
- MA 696 Summer Thesis Research.
- MA 699 Master's Thesis Preparation.
- MA(ST,OR) 706 Nonlinear Programming.
- MA(OR) 708 Integer Programming.
- MA 711 Analytic Function Theory I.
- MA 712 Analytic Function Theory II.
- MA 713 Techniques of Complex Analysis.
- MA 715 Analysis II.
- MA 716 Advanced Functional Analysis.
- MA(OR) 719 Vector Space Methods in System Optimization.
- MA 720 Lie Algebras.
- MA 721 Abstract Algebra II.
- MA 723 Theory of Matrices and Applications.

MA(E,OR) 731 Dynamic Systems and Multivariable Control II.
MA 732 Ordinary Differential Equations II.
MA 734 Partial Differential Equations.
MA 735 Stability and Time Optimal Control of Hereditary Systems II.
MA(ST) 746 Introduction to Stochastic Processes.
MA(ST) 747 Probability and Stochastic Processes II.
MA(ST) 748 Stochastic Differential Equations.
MA 751 Topology.
MA 753 Algebraic Topology.
MA 755 Introduction to Riemannian Geometry.
MA 756 Geometrical Structures on Fiber Bundles.
MA(IE,OR) 766 Network Flows.
MA(BMA,ST) 771 Biomathematics I.
MA(BMA,ST) 772 Biomathematics II.
MA(BMA,OR,ST) 773 Stochastic Modeling.
MA 775 Mathematical Methods in the Physical Sciences I.
MA 776 Mathematical Methods in the Physical Sciences II.
MA(NE) 777 Exact and Approximate Solutions in Particle Transport Theory.
MA(ST) 778, 779 Measure Theory and Advanced Probability.
MA(CSC) 780 Numerical Analysis II.
MA 782 Advanced Numerical Linear Algebra.
MA(CSC) 783 Parallel Algorithms and Scientific Computation.
MA 784 Nonlinear Equations and Unconstrained Optimization.
MA 785 Numerical Solution of Ordinary Differential Equations.
MA 788 Numerical Nonlinear Partial Differential Equations.
MA(IE,OR) 790 Advanced Special Topics in System Optimization.
(The subject matter in the following special topics courses varies from year to year. The topics and instructors are announced well in advance by the department.)
MA 791 Special Topics in Real Analysis.
MA 792 Special Topics in Algebra.
MA 793 Special Topics in Differential Equations.
MA 795 Special Topics in Topology.
MA 796 Special Topics in Combinatorial Analysis.
MA 797 Special Topics in Applied Mathematics.
MA 798 Special Topics in Numerical Analysis.
MA(OE,OR) 812 Special Topics in Mathematical Programming.
MA(IE,OR) 816 Advanced Special Topics in Systems Analysis and Optimization.
MA 885 Doctoral Supervised Teaching.
MA 890 Doctoral Preliminary Examination.
MA 893 Doctoral Supervised Research.
MA 895 Doctoral Dissertation Research.
MA 896 Summer Dissertation Research.
MA 899 Doctoral Dissertation Preparation.

Mathematics Education

For a listing of graduate faculty and program information, see mathematics, science and technology education.

Math, Science, and Technology Education

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Mathematics Education	Y		Y			Y
Occupational Education		Y	Y			Y
Science Education	Y		Y			Y
Technology Education		Y	Y			Y

GRADUATE FACULTY

J. E. Penick, *Head of the Department*

Director of Graduate Programs:

G. E. Moore, Box 7607, 515.1756, gary_moore@ncsu.edu

J. E. Penick, Box 7801, 515.6900, john_penick@ncsu.edu

R. E. Wenig, Box 7801, 515.1742, robert_wenig@ncsu.edu

Professors: S. B. Berenson, L. M. Clark, J. R. Kolb, G. E. Moore, J. E. Penick, L. V. Stiff;

Adjunct Professors: J. S. Lee; **Professors Emeriti:** D. A. Adams, N. D. Anderson, J. K. Coster, W. L. Cox Jr., D. M. Hanson, D. W. Olson, C. C. Scarborough; **Associate Professors:** V. W. DeLuca, J. L. Flowers, W. J. Haynie III, K. S. Norwood, J. C. Park, R. E. Peterson, W. M. Waters Jr., L. W. Watson, R. E. Wenig, J. H. (. Wheatley); **Research Associate Professors:** H. S. Stubbs; **Associate Professors Emeriti:** C. D. Bryant, T. R. Miller, H. A. Shannon; **Assistant Professors:** T. J. Branoff, S. M. Butler, G. S. Carter, H. S. Drier, S. L. Westbrook, E. N. Wiebe; **Visiting Assistant Professors:** A. C. Clark, K. R. Dawkins, G. R. Haynie; **Adjunct Assistant Professors:** W. Smith Jr.; **Assistant Professors Emeriti:** J. L. Crow, T. C. Shore Jr., W. J. Vander Wall

The Department of Mathematics, Science and Technology Education offers graduate programs in technology education that leads to the degrees of Master of Science, Master of Education and Doctor of Education. Students take courses in their educational specialty, in general professional education and in a social science cognate area. Graduate programs in mathematics education and science education lead to the degrees of Master of Science, Master of Education and Doctor of Philosophy. Students take courses in their educational specialty in one of the teaching specializations: biological sciences, chemistry, computer science, earth science, interdisciplinary science, mathematics, physics or statistics.

Master's programs are offered leading to graduate-level (G) certification as a teacher of mathematics, science, technology or occupational exploration at grades 6-9 or 9-12 for those who have initial (A) certification. Programs are also available for those seeking advanced graduate-level (AG) certification as a teacher or certification as a local vocational director. Students may choose a program to prepare for teaching careers in post-secondary education.

Admission Requirements: Applicants for all of the M.S. and M.Ed. degrees and Ed.D. in technology education may submit recent scores from the GRE General Test or on the Miller's Analogy Test. Applicants for the Ph.D. in mathematics education or science education must submit recent scores from the GRE General Test. Academic and professional background necessary for admission differs by specific program.

Master's Degree Requirements: The master's degree programs require a minimum of 36 semester hours of graduate work. Students who elect the M.S. substitute up to 6 semester hours of thesis research for part of the course load.

Doctoral Degree Requirements: (Ed.D.) A minimum of 90 semester hours of graduate work beyond the baccalaureate degree is required including a minimum of 12 semester hours of dissertation research. (Ph.D.) A minimum of 45 semester hours of course work, a minimum of 12 semester hours of dissertation research and one foreign language is required beyond the master's degree requirements. For both degrees, students may be required to supplement their course work with internships and/or other experiential activities to meet competencies.

Student Financial Support

A small number of teaching and research assistantships are available and out-of-state tuition remission may be available for one year to students on assistantships.

GRADUATE COURSES

EMS 511 Implications of Mathematical Content, Structure and Processes for the Teaching of Mathematics in the Elementary School.

EMS 570 Foundations of Mathematics Education.

EMS 575 Foundations of Science Education.

EMS 577 Improving Classroom Instruction in Science.

EMS 591 Special Problems in Mathematics Teaching.

EMS 592 Special Problems in Science Teaching.

EMS 621 Special Problems in Mathematics Teaching.

EMS 622 Special Problems in Science Teaching.

EMS 641 Practicum in Science and Mathematics Education.

EMS 651 Internship in Mathematics, Science and Technology Education.

EMS 685 Master's Supervised Teaching.

EMS 686 Teaching in College.

EMS 690 Master's Examination.

EMS 692 Master's Research Project.

EMS 693 Master's Supervised Research.

EMS 695 Master's Thesis Research.

EMS 696 Summer Thesis Research.

EMS 699 Master's Thesis Preparation.

EMS 703 Teaching Mathematics and Science in Higher Education.

EMS 704 Curriculum Development and Evaluation in Science and Mathematics.

EMS 705 Education and Supervision of Teachers of Mathematics and Science.

EMS 709 Seminar in Occupational Education.

EMS 712 Teaching Mathematics in Elementary and Junior High School.

EMS 770 Foundations of Mathematics Education.

EMS 775 Foundations of Science Education.

EMS 777 Improving Classroom Instruction in Science.

EMS 786 Teaching in College.

EMS 792 Special Problems in Mathematics Teaching.

EMS 794 Special Problems in Science Teaching.

EMS 797 Special Topics.

EMS 802 Seminar in Mathematics Education.

EMS 803 Seminar in Science Education.

EMS 821 Special Problems in Mathematics Teaching.
EMS 822 Special Problems in Science Teaching.
EMS 841 Practicum in Science and Mathematics Education.
EMS 851 Internship in Mathematics, Science and Technology Education.
EMS 885 Doctoral Supervised Teaching.
EMS 890 Doctoral Preliminary Examination.
EMS 892 Doctoral Research Project.
EMS 893 Doctoral Supervised Research.
EMS 895 Doctoral Dissertation Research.
EMS 896 Summer Dissertation Research.
EMS 899 Doctoral Dissertation Preparation.
EOE 610 Special Topics.
EOE 621 Special Problems in Occupational Education.
EOE 641 Practicum in Occupational Education.
EOE 651 Internship in Occupational Education.
EOE 662 Planning and Organizing Industrial and Technical Education Programs.
EOE 685 Master's Supervised Teaching.
EOE 690 Master's Examination.
EOE 692 Master's Research Project.
EOE 693 Master's Supervised Research.
EOE 695 Master's Thesis Research.
EOE 696 Summer Thesis Research.
EOE 699 Master's Thesis Preparation.
EOE 701 Philosophy of Occupational Education.
EOE 702 Laws, Regulations and Policies Affecting Occupational Education.
EOE 705 Curriculum Materials Development.
EOE 706 Cooperative Occupational Education.
EOE 710 Career Exploration.
EOE 712 Analysis of Occupational Information, Trends and Labor Market.
EOE 722 Finance, Accounting and Management of Occupational Education Programs.
EOE 751 Technology Education: a Discipline.
EOE 752 Curricula for Emerging Technologies.
EOE 755 Developing and Implementing Technology Education.
EOE 758 Teaching Creative Problem Solving.
EOE 765 Advanced Trade Analysis and Course Construction.
EOE 779 Research Application in Occupational Education.
EOE 802 Seminar in Occupational Education.
EOE 810 Special Topics.
EOE 821 Special Problems in Occupational Education.
EOE 841 Practicum in Occupational Education.
EOE 851 Internship in Occupational Education.
EOE 885 Doctoral Supervised Teaching.
EOE 892 Doctoral Research Project.
EOE 895 Doctoral Dissertation Research.
EOE 896 Summer Dissertation Research.
EOE 899 Doctoral Dissertation Preparation.
TED 623 Laboratory Problems in Industrial Arts.
TED 709 Seminar in Technology Education.
TED 745 Technology and Industrial Arts
TED 797 Special Topics in Technology Education.
TED 823 Laboratory Problems in Industrial Arts

Mechanical Engineering

For a listing of graduate faculty and program information, see mechanical and aerospace engineering.

Mechanical and Aerospace Engineering

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Aerospace Engineering	Y		Y			
Mechanical Engineering	Y		Y		Y	

GRADUATE FACULTY

M. N. Noori, *Head of the Department*

Director of Graduate Programs:

R. D. Gould, Box 7910, 515.5236, gould@eos.ncsu.edu

Graduate Alumni Distinguished Professor: F. R. DeJarnette, H. A. Hassan

Professors: J. A. Bailey, N. Chokani, T. A. Dow, H. M. Eckerlin, R. F. Keltie, C. Kleinstreuer, D. S. McRae, R. T. Nagel, M. N. Noori, L. H. Royster, L. M. Silverberg, J. S. Strenkowski; **Research Professors:** J. S. Stewart; **Visiting Professors:** M. M. Fikry; **Adjunct Professors:** J. P. Archie Jr., A. E. Bayoumi, D. P. DeWitt, D. E. Klett, G. K. F. Lee, E. R. McClure; **Professors Emeriti:** M. H. Clayton, W. C. Griffith, F. J. Hale, F. D. Hart, T. H. Hodgson, C. J. Maday, J. C. Mulligan, J. N. Perkins, F. O. Smetana, F. Y. Sorrell Jr., G. D. Walberg, J. K. Whitfield, C. F. Zorowski; **Associate Professors:** M. A. Boles, J. R. Edwards Jr., J. W. Eischen, R. D. Gould, C. E. Hall Jr., R. R. Johnson, E. C. Klang, J. W. Leach, K. M. Lyons, M. K. Ramasubramanian, P. I. H. Ro, W. L. Roberts IV, A. J. Shih, F. Yuan, M. A. Zikry; **Adjunct Associate Professors:** J. G. Cleland, L. P. Franzoni, J. H. Hebrank, C. S. Kim, D. W. Lee, R. M. Potter Jr.; **Assistant Professors:** G. D. Buckner, A. Gopalarathnam, K. J. Peters, A. Rabiei, F. Wu; **Visiting Assistant Professors:** A. V. Kuznetsov; **Adjunct Assistant Professors:** D. P. Colvin, J. A. Cooke, B. Driehuys, K. J. Falter, A. O. Hobbs, S. D. Holland, M. A. Norris, M. T. Odman, S. C. Southward, R. J. Stanley II; **Interinstitutional Faculty:** G. A. Truskey

Course offerings and research programs are available in the following areas: thermodynamics and energy conversion, heat and mass transfer, fluid mechanics, combustion, acoustics and noise control, machine design, vibration, gas dynamics and aerodynamics, aeroelasticity, CFD, finite elements, structures, controls, precision engineering, materials processing and tribology.

Admission Requirements: An applicant to the master's program must be a graduate of an accredited undergraduate program with a B.S. degree in either mechanical or aerospace engineering. Graduates of other accredited programs in engineering, physical sciences and mathematics may be considered but will be required to make up undergraduate deficiencies without graduate credit. Provisional admissions, as well as exceptions, are sometimes granted under special circumstances. The most qualified applicants are accepted first. Applicants to the Ph.D. program must have met the M.S. admission requirements, completed the M.S. degree in mechanical engineering or aerospace engineering and additionally must satisfy the Ph.D. qualifying requirements.

Master's Degree Requirements: The non-thesis Master of Mechanical Engineering degree requires 27 hours of course credit and a six-hour project.

Ph.D. Degree Requirements: A minimum of 54 hours of credit beyond the master's program is required.

Student Financial Support: Various types of assistantships and fellowships are available. Awards are made to the most qualified applicants first and generally are not available for all students.

Other Relevant Information: Each new student chooses an area of specialty, selects an advisor and committee, customizes a program of study and begins research in the first semester of residence. The Director of Graduate Programs acts as a temporary advisor initially and should be contacted with questions.

GRADUATE COURSES

- MAE 501 Advanced Engineering Thermodynamics.
- MAE 503 Advanced Power Plants.
- MAE 504 Fluid Dynamics of Combustion I.
- MAE 505 Heat Transfer Theory and Applications.
- MAE 510 Effects of Noise and Vibration on Man.
- MAE 513 Principles of Structural Vibration.
- MAE 514 Noise and Vibration Control.
- MAE 517 Instrumentation in Sound and Vibration Engineering.
- MAE 518 Acoustic Radiation I.
- MAE 521 Linear Control and Design for Mimo Systems.
- MAE 522 Real Time Digital Filtering and Control.
- MAE 524 Principles of Mechatronic Control.
- MAE 525 Advanced Flight Vehicle Stability and Control.
- MAE 526 Inertial Navigation Analysis and Design.
- MAE 527 Mechanics of Machinery.
- MAE 533 Finite Element Analysis I.
- MAE(WPS) 534 Mechatronics Design.
- MAE 537 Mechanics of Composite Structures.
- MAE 540 Advanced Air Conditioning Design.
- MAE 541 Advanced Machine Design I.
- MAE 543 Fracture Mechanics.
- MAE 545 Metrology for Precision Manufacturing.
- MAE 550 Foundations of Fluid Dynamics.
- MAE 551 Airfoil Theory.
- MAE 552 Transonic Aerodynamics.
- MAE 553 Compressible Fluid Flow.
- MAE 554 Hypersonic Aerodynamics.
- MAE 555 Aerodynamic Heating.
- MAE 556 Mechanics of Ideal Fluids.
- MAE 557 Dynamics of Internal Fluid Flow.
- MAE 560 Computational Fluid Mechanics and Heat Transfer.
- MAE 561 Wing Theory.
- MAE 562 Physical Gas Dynamics.
- MAE 573 Hydrodynamic Stability and Transition.
- MAE 586 Project Work in Mechanical Engineering.
- MAE 589 Special Topics in Mechanical Engineering.
- MAE 601 Mechanical and Aerospace Engineering Seminar.
- MAE 685 Master's Supervised Teaching.
- MAE 690 Master's Examination.

MAE 693 Master's Supervised Research.
MAE 695 Master's Thesis Research.
MAE 696 Summer Thesis Research.
MAE 699 Master's Thesis Preparation.
MAE 702 Statistical Thermodynamics.
MAE 704 Fluid Dynamics of Combustion II.
MAE 707 Advanced Conductive Heat Transfer.
MAE 708 Advanced Convective Heat Transfer.
MAE 709 Advanced Radiative Heat Transfer.
MAE 713 Analytical Methods in Structural Vibration.
MAE 715 Nonlinear Vibrations.
MAE 716 Random Vibration.
MAE 718 Acoustic Radiation II.
MAE(E) 720 Industrial Robotics.
MAE(MEA) 725 Geophysical Fluid Mechanics.
MAE(MEA) 726 Advanced Geophysical Fluid Mechanics.
MAE 727 Computational Methods in Structural Vibration.
MAE 730 Modem Plasticity.
MAE(MAT) 731 Materials Processing by Deformation.
MAE(MAT) 732 Fundamentals of Metal Machining Theory.
MAE 734 Finite Element Analysis II.
MAE 736 Photoelasticity.
MAE 741 Advanced Machine Design II.
MAE 742 Mechanical Design for Automated Assembly.
MAE 544 Real Time Robotics.
MAE 766 Computational Fluid Dynamics.
MAE(MEA) 768, 769 Perturbation Method in Fluid Mechanics I, II.
MAE 770 Computation of Reacting Flows.
MAE 774 Dynamics of Real Fluids I.
MAE 775 Dynamics of Real Fluids II.
MAE 776 Turbulence.
MAE 777 Experimental Methods in Fluid Mechanics.
MAE 778 Molecular Gas Dynamics I.
MAE 779 Molecular Gas Dynamics II.
MAE 789 Advanced Topics in Mechanical Engineering.
MAE 801 Mechanical and Aerospace Engineering Seminar.
MAE 885 Doctoral Supervised Teaching.
MAE 890 Doctoral Preliminary Examination.
MAE 893 Doctoral Supervised Research.
MAE 895 Doctoral Dissertation Research.
MAE 896 Summer Dissertation Research.
MAE 899 Doctoral Dissertation Preparation.

Microbiology

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Microbiology	Y		Y		Y	

GRADUATE FACULTY

Director of Graduate Programs:

S. M. Laster, Box 7615, 515.7958, scott_laster@ncsu.edu

Professors: W. J. Dobrogosz, H. M. Hassan, G. H. Luginbuhl, J. M. Mackenzie Jr., L. W. Parks; **Professors (USDA):** P. E. Bishop; **Adjunct Professors:** I. A. Casas, R. E. Kanich, S. R. Tove; **Professors Emeriti:** G. H. Elkan, J. J. Perry; **Associate Professors:** J. W. Brown, S. M. Laster, E. S. Miller, I. T. D. Petty; **Adjunct Associate Professors:** K. T. Kleeman, J. M. Ligon; **Assistant Professors:** A. M. Grunden, M. Hyman, S. J. Libby; **Adjunct Assistant Professors:** W. M. Casey, W. S. Dallas, S. H. Shore

ASSOCIATE MEMBERS OF THE PROGRAM

Professors: T. R. Klaenhammer, D. T. Brown, F. J. Fuller, R. M. Kelly, W. E. Kloos, P. E. Orndorff, J. C. H. Shih; **Associate Professors:** P. Arasu, B. Sherry; **Associate Professors (USDA):** R. G. Upchurch; **Assistant Professors:** C. Altier

The Department of Microbiology is in the College of Agriculture and Life Sciences and has a unique blend of applied and basic research programs. The department offers courses of study and research leading to the Ph.D., M.S. and Master of Microbiology degrees. The graduate program is designed to prepare individuals for careers in academic, industrial or research institute settings. Research in the department emphasizes study of fundamental biological processes, with several programs having important biotechnological, environmental and medical applications.

Admission Requirements: Applications are invited from individuals holding B.S. or M.S. degrees in the physical and life sciences. Applications should ideally be received in the department before January 15 to be considered for Fall semester admission. A written statement should describe the applicant's academic and career goals as well as their area of interest.

Master's Degree Requirements: The M.S. is a research-oriented degree requiring 30 credit hours and a written thesis. For students wishing a more general educational background in microbiology without the thesis requirement, the Master of Microbiology (M.M.) degree is offered. A first-year core curriculum is required for all master's degree students. At least one semester of laboratory instructorship is required.

Doctoral Degree Requirements: The Ph.D. program is designed for individuals desiring to pursue careers in research and teaching. Students enroll in a core curriculum consisting of courses in metabolic regulation/physiology, virology, immunology and molecular genetics. In addition, the student, in consultation with and approval by his/her advisory committee, may select elective courses offered by the Department of Microbiology and by other departments on campus. In conjunction with the advisor, the student establishes a four-member faculty advisory committee to guide the research and academic program. At least two semesters of laboratory instructorship is required. The final examination also includes a seminar presented by the candidate that is open to the university community.

Student Financial Support: Financial support for study in the department is available in the form of teaching assistantships, research assistantships and competitive fellowships. All applications to the department are automatically considered for available assistantships. For highly qualified students, supplemental funds are frequently available.

Other Relevant Information: During the first semester, participation in the laboratory rotation program is required so that students become acquainted with departmental research programs, faculty and other graduate students. A faculty thesis advisor and laboratory research program are

usually selected by the end of the first semester.

GRADUATE COURSES

MB(BO,PP) 501 Fungi and Their Interaction with Plants.

MB(PP) 503 Bacteria and Their Interactions with Plants.

MB(ZO) 555 Protozoology.

MB(BO,PP) 575 Introduction to Mycology.

MB 601 Seminar.

MB 620 Special Problems.

MB 624 Topical Problems.

MB 670 Master's Laboratory Rotations.

MB 680 Master's Microbiology Research Presentations.

MB 685 Master's Supervised Teaching.

MB 686 Teaching Experience.

MB 690 Master's Examination.

MB 693 Master's Supervised Research.

MB 695 Master's Thesis Research.

MB 696 Summer Thesis Research.

MB 699 Master's Thesis Preparation.

MB 703 Microbial Diversity.

MB 705 Biological Scanning Electron Microscopy.

MB 710 Biological Transmission Electron Microscopy.

MB 711 Ultramicrotomy for Life Sciences.

MB 714 Microbial Metabolic Regulation.

MB 718 Introductory Virology.

MB(FS) 725 Fermentation Microbiology.

MB(BO,GN,PP) 730 Fungal Genetics and Physiology.

MB(SSC) 732 Soil Microbiology.

MB(IMM) 751 Immunology.

MB(CBS,IMM,PHY,PO) 756 Immunogenetics.

MB(GN) 758 Prokaryotic Molecular Genetics.

MB(GN) 760 Experimental Microbial Genetics.

MB 771 Molecular Virology of Animal Viruses.

MB(BO) 774 Phycology.

MB(BO,PP) 775 The Fungi.

MB(BO,PP) 776 The Fungi - Lab.

MB(CBS) 783 Advanced Immunology.

MB 801 Seminar.

MB 820 Special Problems.

MB 824 Topical Problems.

MB 870 Doctoral Laboratory Rotations.

MB 880 Doctoral Microbiology Research Presentations.

MB 885 Doctoral Supervised Teaching.

MB 886 Teaching Experience.

MB 890 Doctoral Preliminary Examination.

MB 893 Doctoral Supervised Research.

MB 895 Doctoral Dissertation Research.

MB 896 Summer Dissertation Research.

MB 899 Doctoral Dissertation Preparation.

Middle Grades Education

For a listing of graduate faculty and program information, see curriculum and instruction.

Natural Resources

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Natural Resources			Y		Y	

GRADUATE FACULTY

Director of Graduate Programs:

B. E. Wilson, Box 8004, 515.3665, beth_wilson@ncsu.edu, Parks, Recreation and Tourism Management

R. L. Mikkelsen, Box 7619, 513.3033, robert_mikkelsen@ncsu.edu, Soil Science

S. E. McKeand, Box 8002, 515.7563, steve_mckeand@ncsu.edu, Forestry

Professors: F. W. Cubbage, H. A. Devine, J. D. Gregory, H. J. Kleiss, J. D. Wellman; *Associate Professors:* R. C. Abt, L. D. Gustke, R. L. Moore

The natural resources program is an interdepartmental program designed to prepare students for administrative and research positions in both private and public natural resource organizations. A core curriculum of 16 credit hours provides all NR students with courses in administration, economics, policy, statistics and current natural resource issues. For the remaining approximately 17 credits, students elect a technical option administered by one of the three participating departments. Currently approved technical options include: forest economics and management, forest policy and administration, international resources and spatial information systems in the Department of Forestry; outdoor recreation management and spatial information systems in the Department of Parks, Recreation and Tourism Management and soil science in the Department of Soil Science. With one exception, each option is available as either the M.S. in NR or as the non-thesis Master of NR. The soil science option is available only as the non-thesis degree.

Admissions Requirements: Students should have an undergraduate degree in natural resources or a related field. Experience in natural resources management and administration will be considered in lieu of an appropriate undergraduate degree. Admission is contingent upon acceptance by an advisor.

Master's Requirements: The M.S. degree requires a research thesis based on completion of a research project. The Master of NR degree requires a practical project which develops and demonstrates problem-solving skills.

Core Courses (15 credit hours)

ECG 515 Environmental and Resource Policy or EC(ARE) 436 Environmental Economics.

NR 571 Current Issues in Natural Resource Policy.

PA 500 Public Administration or PA 511 Public Policy Analysis.

ST 501 Experimental Statistics for Biological Science I or a higher level statistics course.

GRADUATE COURSES

NR 500 Natural Resource Management.
NR(FOR) 520 Watershed and Wetlands Hydrology.
NR 521 Wetland Assessment, Delineation and Regulation.
NR 571 Current Issues in Natural Resource Policy.
NR 595 Special Topics in Natural Resources
NR 601 Graduate Seminar
NR 610 Special Topics in Natural Resources
NR 685 Master's Supervised Teaching.
NR 690 Master's Examination.
NR 693 Master's Supervised Research.
NR 695 Master's Thesis Research.
NR 696 Summer Thesis Research.
NR 699 Master's Thesis Preparation.

Nuclear Engineering

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Nuclear Engineering	Y		Y		Y	

GRADUATE FACULTY

P. J. Turinsky, *Head of the Department*

Director of Graduate Programs:

R. M. Mayo, Box 7909, 515.5876, rmayo@ncsu.edu

Graduate Alumni Distinguished Professor: R. P. Gardner

Professors: M. A. Bourham, D. J. Dudziak, J. G. Gilligan, C. W. Mayo, K. L. Murty, P. J. Turinsky, K. Verghese; **Adjunct Professors:** R. M. Lindstrom, M. S. Wechsler; **Professors Emeriti:** R. L. Murray, E. Stam; **Associate Professors:** J. M. Doster, R. M. Mayo; **Assistant Professors:** D. Y. Anistratov, O. E. Hankins, M. Yim; **Adjunct Assistant Professors:** D. J. Kropaczek

The discipline of nuclear engineering is concerned with the development of nuclear processes for energy production and with the applications of radiation for the benefit of society. Representative topics of investigation include analytic, computational and experimental research in the neutronics, materials, thermal-hydraulics and control aspects of fission reactors; radiation detection and measurement of basic physics parameters; waste management and radiological assessment; applications of radioisotopes and radiation in industry, medicine and science; and plasma, plasma-material surface interactions and design aspects of fusion reactors.

Admission Requirements: Bachelor's degree graduates in any of the fields of engineering or physical sciences may be qualified for successful advanced study in nuclear engineering. Prior experience or course work in nuclear physics, partial differential equations and basic reactor analysis is helpful but may be gained during the first semester of graduate study. GRE scores (general test) are usually needed for financial aid.

Master's Degree Requirements: A project is required for the MNE degree. A minor (nine semester hours) must be selected for both the M.S. and MNE degrees.

Doctoral Degree Requirements: Students must pass a departmental qualifying exam that covers basic nuclear engineering material. Students must select a minor (typically 15-18 hours).

Student Financial Support: Teaching assistantships, research assistantships and fellowships are available for qualified applicants. Opportunities are also available for graduate traineeships with utility companies, reactor manufacturers and national laboratories providing a valuable combination of financial support and learning in the classroom, the research laboratory and on the job.

Other Relevant Information: The department has many excellent facilities including the one-megawatt PULSTAR fission reactor, the Scaled PWR Facility (SPWRF), neutron activation analysis laboratory, nuclear materials laboratory, plasma and fusion laboratories, instrumentation and controls equipment, radiation analyzers and tomography systems, and computers ranging from workstations to a supercomputer.

GRADUATE COURSES

- NE 504 Radiation, Safety and Shielding.
- NE 505 Reactor Systems.
- NE 508 Radiation Safety.
- NE(MAT) 509 Nuclear Materials.
- NE 511 Nuclear Physics for Engineers.
- NE 512 Nuclear Fuel Cycles.
- NE 520 Radiation and Reactor Fundamentals.
- NE(PY) 528 Introduction Plasma Physics and Fusion Energy.
- NE 531 Nuclear Waste Management.
- NE 585 Hazardous Waste Management.
- NE 591, 592 Special Topics in Nuclear Engineering I, II.
- NE 601 Seminar.
- NE 685 Master's Supervised Teaching.
- NE 690 Master's Examination.
- NE 693 Master's Supervised Research.
- NE 695 Master's Thesis Research.
- NE 696 Summer Thesis Research.
- NE 699 Master's Thesis Preparation.
- NE 721 Nuclear Laboratory Fundamentals.
- NE 722 Reactor Dynamics and Control.
- NE 723 Reactor Analysis.
- NE 724 Reactor Heat Transfer.
- NE 726 Radioisotope Measurement Applications.
- NE 727 Nuclear Engineering Analysis.
- NE 730 Radiological Assessment.
- NE 732 Principles of Industrial Plasmas.
- NE 740 Laboratory Projects in Nuclear Engineering.
- NE 745 Plasma Generation and Diagnostics Laboratory.

NE 746 Fusion Energy Engineering.
NE 750 Laboratory Projects in Nuclear Engineering.
NE 751 Nuclear Reactor Design Calculations.
NE 752 Thermal Hydraulic Design Calculations.
NE 753 Reactor Kinetics and Control.
NE 755 Reactor Theory and Analysis.
NE 757 Radiation Effects on Materials.
NE 761 Radiation Detection.
NE 762 Radioisotope Applications.
NE 770 Nuclear Radiation Attenuation.
NE(MAT) 773 Computer Experiments in Materials and Nuclear Engineering.
NE(MA) 777 Exact and Approximate Solutions in Particle Transport Theory.
NE 780 Magnetohydrodynamics and Transport in Plasmas.
NE 781 Kinetic Theory, Waves and Non-linear Effects in Plasmas.
NE 795, 796 Advanced Topics in Nuclear Engineering I, II.
NE 801 Seminar.
NE 885 Doctoral Supervised Teaching.
NE 890 Doctoral Preliminary Examination.
NE 893 Doctoral Supervised Research.
NE 895 Doctoral Dissertation Research.
NE 896 Summer Dissertation Research.
NE 899 Doctoral Dissertation Preparation.

Nutrition

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Nutrition	Y		Y		Y	

GRADUATE FACULTY

Director of Graduate Programs:

J. C. Allen, Box 7624, 513.2257, jon_allen@ncsu.edu

William Neal Reynolds Professor: W. E. Donaldson, H. E. Swaisgood

Professors: J. C. Allen, B. P. Alston-Mills, J. T. Brake, L. S. Bull, G. L. Catignani, J. H. Eisemann, W. M. Hagler Jr., C. J. Lackey, J. F. Ort, J. C. H. Shih, R. C. Smart, J. W. Spears, L. W. Whitlow; **Professors Emeriti:** L. W. Aurand, E. S. Cofer, R. W. Harvey, C. H. Hill, W. L. Johnson, E. E. Jones, J. R. Jones, R. D. Mochrie, A. H. Rakes, H. A. Ramsey, S. J. Schwartz, F. H. Smith, G. H. Wise; **Associate Professors:** K. E. Anderson, L. C. Boyd, P. R. Ferket, J. L. Grimes, B. A. Hopkins, J. W. McClelland, J. Odle, M. H. Poore; **Assistant Professors:** S. L. Ash, J. Luginbuhl, J. A. Moore, E. van Heugten, T. A. van Kempen

The interdepartmental nutrition program consist of faculty from five departments (animal science, family and consumer sciences, food science, poultry science and toxicology). Students reside and conduct research in one of these departments under the direction of an appropriate advisor.

Research in the nutrition program may be conducted with a variety of species and at levels ranging from the molecular to the whole animal. Research programs are primarily in the area of nutritional

biochemistry or experimental animal nutrition.

Admission Requirement: To be considered for admission, a student should have a B.S. or M.S. degree in a science-related area.

Master's Degree Requirements: A minimum of 24 course credit hours is required for M.S., 36 for Master of Nutrition.

Student Financial Support: Assistantships and fellowships are available on a competitive basis from the departments in which the advisor resides.

GRADUATE COURSES

NTR(ANS) 516 Animal Nutrition Research Methods.
NTR(ANS) 550 Applied Ruminant Nutrition.
NTR(ANS,FS) 554 Lactation and Milk Consumption.
NTR 597 Master's Seminar.
NTR 601 Master's Seminar.
NTR 624 Topical Problems.
NTR 625 Advanced Special Problems.
NTR 685 Master's Supervised Teaching
NTR 690 Master's Examination.
NTR 693 Master's Supervised Research.
NTR 695 Master's Thesis Research.
NTR 696 Summer Thesis Research.
NTR 699 Master's Thesis Preparation.
NTR 701 Protein and Amino Acid Metabolism
NTR(FS) 706 Vitamin Metabolism.
NTR(ANS) 709 Energy Metabolism.
NTR(FS) 730 Human Nutrition.
NTR(ANS,CBS,PHY) 764 Comparative Physiology of Digestive Systems.
NTR(ANS,PO) 775 Mineral Metabolism.
NTR(ANS) 785 Digestion and Metabolism in Ruminants.
NTR 797 Doctoral Seminar.
NTR 801 Doctoral Seminar.
NTR 824 Topical Problems
NTR 825 Advanced Special Problems.
NTR 885 Doctoral Supervised Teaching.
NTR 890 Doctoral Preliminary Examination.
NTR 893 Doctoral Supervised Research.
NTR 895 Doctoral Dissertation Research.
NTR 896 Summer Dissertation Research.
NTR 899 Doctoral Dissertation Preparation.

Occupational Education

For a listing of graduate faculty and program information, see mathematics, science and technology education..

Operations Research

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Operations Research	Y		Y		Y	

GRADUATE FACULTY

Director of Graduate Programs:

X. Chao, Box 7913, 513.4472, xchao@eos.ncsu.edu

Graduate Alumni Distinguished Professor: B. B. Bhattacharyya

University Professor: S. E. Elmaghhraby

Professors: R. H. Bernhard, S. L. Campbell, X. Chao, W. Chou, J. C. Dunn, S. Fang, R. E. Funderlic, R. E. Hartwig, T. J. Hodgson, D. M. Holthausen Jr., C. T. Kelley, R. E. King, C. D. Meyer Jr., A. A. J. Nilsson, H. L. Nuttle, H. G. Perros, E. L. Peterson, S. D. Roberts, C. D. Savage, L. A. Stefanski, W. J. Stewart, M. W. Suh, M. A. Vouk, J. R. Wilson; *Professors Emeriti:* J. W. Bishir, H. J. Gold; *Associate Professors:* Y. Fathi, T. L. Honeycutt, T. W. Reiland, J. Rodriguez, J. P. Roise, G. N. Rouskas, C. E. Smith, M. F. M. Stallmann, H. T. Tran, I. Viniotis; *Assistant Professors:* W. M. McEneaney

ASSOCIATE MEMBERS OF THE PROGRAM

Associate Professors: M. P. Singh

Operations research is a graduate program of an interdisciplinary nature, governed by an administrative board and the program committee, and administered through the office of the program director.

Admission Requirements: Applications for a master's degree program are accepted normally from undergraduate majors in mathematical sciences and engineering. Applications for the doctoral degree program are accepted normally from holders of a master's degree from a recognized program (preferably an OR program or one of its allied fields) who show promise of success at the Ph.D. level, as indicated by previous academic performance and independent research.

A score on the GRE that is less than two years old is required if financial assistance is sought or if the student is transferring from another doctoral program.

Master's Degree Requirements: The Master of Operations Research degree is a terminal graduate degree for students who seek careers as OR practitioners in either the private or public sector. The M.S. degree is designed to prepare students for careers in research and development.

Doctoral Degree Requirements: The Ph.D. degree is intended for students to be research

scientists in industry or teachers and researchers in academia. Please consult the OR brochure for more details of degree requirements.

Student Financial Support: Both teaching and research assistantships are available to qualified applicants. Outstanding students who are U.S. citizens and who shall be enrolled in the NC State Graduate School for the first time are eligible for the Engineering Dean's Graduate Fellowship Program.

CENTRAL GRADUATE COURSES

- OR 501 Introduction to Operations Research.
- OR 502 Introduction to Systems Theory.
- OR(MA) 504 Introduction to Mathematical Programming.
- OR(IE,MA) 505 Linear Programming.
- OR 506 Algorithmic Methods in Nonlinear Programming.
- OR(CHE) 527 Optimization of Engineering Processes.
- OR(E,MA) 531 Dynamic Systems and Multivariable Control I.
- OR(CSC,MA) 565 Graph Theory.
- OR(CSC,ECE) 579 Introduction to Computer Performance Modeling.
- OR 591 Special Topics.
- OR 601 Seminar.
- OR 610 Special Topics.
- OR 615 Advanced Special Topics
- OR 652 Practicum in Operations Research.
- OR 685 Master's Supervised Teaching.
- OR 690 Master's Examination.
- OR 693 Master's Supervised Research.
- OR 695 Master's Thesis Research.
- OR 696 Summer Thesis Research.
- OR 699 Master's Thesis Preparation.
- OR 705 Large Scale Linear Programming Systems.
- OR(MA,ST) 706 Nonlinear Programming.
- OR(MA) 708 Integer Programming.
- OR(IE) 709 Dynamic Programming.
- OR 710 Advanced Dynamic Programming.
- OR(MA) 719 Vector Space Methods in System Optimization.
- OR(BMA,ST) 722 Decision Analytic Modeling.
- OR(IE) 726 Theory of Activity Networks.
- OR(E,MA) 731 Dynamic Systems and Multivariable Control II.
- OR(IE) 761 Queues and Stochastic Service Systems
- OR(CSC,ECE,IE) 762 Computer Simulation Techniques.
- OR(IE,MA) 766 Network Flows.
- OR(IE) 772 Stochastic Simulation Design and Analysis.
- OR(BMA,MA,ST) 773 Stochastic Modeling.
- OR(BMA) 774 System Modeling Theory.
- OR(IE,MA) 790 Advanced Special Topics in Systems Analysis and Optimization.
- OR 791 Advanced Special Topics.
- OR 801 Seminar.
- OR 810 Special Topics.
- OR(IE,MA) 812 Special Topics in Mathematical Programming.
- OR 815 Advanced Special Topics.
- OR(IE,MA) 816 Advanced Special Topics in System Optimization.
- OR 852 Practicum in Operations Research.
- OR(IE) 862 Scheduling and Routing.
- OR 885 Doctoral Supervised Teaching.
- OR 890 Doctoral Preliminary Examination.
- OR 893 Doctoral Supervised Research.
- OR 895 Doctoral Dissertation Research.
- OR 896 Summer Dissertation Research.

SUGGESTED COGNATE COURSES

Cognate courses are courses that are often included in OR programs of study, but which carry other departmental designations. They cover subject matter closely related to OR, and provide additional insight into the theory or application of OR methodology. Students may include cognate courses in their programs of study with the consent of their faculty advisor.

BMA(MA,ST) 771, 772 Biomathematics I, II.
CSC 505 Design and Analysis of Algorithms.
CSC(MA) 580 Numerical Analysis I.
CSC(ECE) 779 Advanced Computer Performance Modeling.
CSC(MA) 780 Numerical Analysis II.
ECE 521 Digital Computer Technology and Design.
ECE 716 Feedback Control Systems.
ECG 750 Economic Decision Theory.
ECG(ST) 751 Econometrics.
ECG(ST) 752 Topics in Econometrics.
IE 723 Production Planning, Scheduling and Inventory Control.
IE 747 Reliability Engineering.
IE 748 Quality Engineering.
MA 523 Linear Transformations and Matrix Theory.
MA(ST) 546 Theory of Probability.
MA 715 Functional Analysis I.
MA 723 Theory of Matrices and Applications.
MA(ST) 746 Introduction to Stochastic Processes.
MA(ST) 778, 779 Measure Theory and Advanced Probability.
MA 798 Special Topics in Numerical Analysis.
ST 730 Applied Time Series Analysis.
ST 782, 783 Time Series Analysis I, II.
ST 785 Introduction to Statistical Decision Theory.

Parks, Recreation, and Tourism Management

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Parks, Recreation and Tourism Mgmt.	Y		Y		Y	

GRADUATE FACULTY

P. S. Rea, *Head of the Department*

Director of Graduate Programs:

B. E. Wilson, Box 8004, 515.3665, beth_wilson@ncsu.edu

Professors: H. A. Devine, P. S. Rea, C. D. Siderelis, J. D. Wellman; **Professors Emeriti:** W. E. Smith, R. E. Sternloff, M. R. Warren Jr.; **Associate Professors:** A. Attarian, G. L. Brothers, C. Goode, L. D. Gustke, C. S. Love, R. L. Moore, B. E. Wilson; **Visiting Associate Professors:** P. K.

Baran; Associate Professors Emeriti: L. L. Miller; Assistant Professors: M. A. Kanders, Y. Leung, N. G. McGehee; Adjunct Assistant Professors: R. W. Wade

The master's degree provides students the opportunity to develop and enhance their critical understanding of both the conceptual foundations of parks, recreation and tourism management and the procedures of systematic inquiry and critical problem solving as applied to planning and management issues. The department offers educational opportunities and resources for the preparation of professionals concerned with planning, organizing, managing and directing parks, recreation and tourism programs, areas and facilities. The general emphasis areas at the master's level include: parks and recreation management, tourism development and management, geographic information systems, recreational sport management and natural resource recreation management.

The doctoral students' programs of study are tailored to match their particular experiences and aspirations, and all doctoral programs will concentrate on one of three areas. All three concentrations operate within the framework of natural resource management and include park and recreation management, tourism policy and development, and spatial information systems and models.

Master's Degree Requirements: The M.S. degree requires 30 credit hours, of which four hours is master's thesis research. The M.P.R.T. requires a minimum of 36 hours of course work, of which two hours is a master's research project. A minor is optional with both degrees. The department offers a co-major with public administration which includes 41 hours of course work. The M.N.R. degree requires a minimum of 30-33 hours.

Doctoral Degree Requirements: Although each doctoral course of study will be unique to the individual student, the normal course of study will include a minimum of 54 hours beyond the master's. These credit hours are distributed among the core courses, statistics and research methods, the minor, the field of expertise and 11 elective hours including the dissertation. Students will be expected to have completed a master's degree, preferably one with a thesis. Students not possessing a master's will have to demonstrate their ability to do graduate work prior to admission into the Ph.D. program as will those without research experience who will have to demonstrate an ability to produce scholarly work in PRTM.

Student Financial Support: Graduate assistantships and internships are available to students in this program on a competitive basis.

GRADUATE COURSES

- PRT 500 Theories of Leisure and Recreation.
- PRT 501 Research Methods in Recreation.
- PRT(ECG) 503 Economics of Recreation.
- PRT 504 Recreation and Park Data Systems.
- PRT 505 Quantitative Techniques for Recreation and Natural Resource Management.
- PRT 507 Services, Facilities and Event Marketing.
- PRT 510 Theories of Sport and Fitness Program Management.
- PRT 511 Foundations for Sport, Exercise and Fitness Program Management.
- PRT 512 Recreational Sport Management.
- PRT 520 Concepts of Travel and Tourism.
- PRT 550 Outdoor Recreation Behavior.
- PRT 562 Introduction to Geographic Information Systems.
- PRT 563 Technical Issues in Geographic Information Systems.

PRT 580 Current Issues in Recreation Resources.
PRT 601 Seminar.
PRT 602 Recreation Management Seminar I.
PRT 603 Recreation Management Seminar II
PRT 610 Special Topics.
PRT 620 Special Problems.
PRT 625 Advanced Problems.
PRT 660 Field Studies in Recreation.
PRT 685 Master's Supervised Teaching.
PRT 690 Master's Examination.
PRT 693 Master's Supervised Research.
PRT 695 Master's Thesis Research.
PRT 696 Summer Thesis Research.
PRT 699 Master's Thesis Preparation.
PRT 763 Application Issues in Geographic Information Systems.
PRT 764 Advanced Study in Geographic Information Systems.
PRT 795 Special Topics in Recreation Resources.
PRT 801 Seminar.
PRT 820 Special Problems.
PRT 885 Doctoral Supervised Teaching.
PRT 890 Doctoral Preliminary Examination.
PRT 893 Doctoral Supervised Research.
PRT 895 Doctoral Dissertation Research.
PRT 896 Summer Dissertation Research.
PRT 899 Doctoral Dissertation Preparation.

Physics

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Physics	Y		Y			

GRADUATE FACULTY

C. R. Gould, *Head of the Department*

Director of Graduate Programs:

M. A. Paesler, Box 8202, 515.8706, paesler@ncsu.edu

Graduate Alumni Distinguished Professor: G. E. Mitchell

University Professor: G. Lucovsky

Professors: D. E. Aspnes, J. Bernholc, K. T. Chung, S. R. Cotanch, D. C. Ellison, R. E. Fornes, C. R. Gould, D. G. Haase, C. Ji, C. E. Johnson, J. Krim, F. Lado Jr., J. R. Mowat, R. J. Nemanich, M. A. Paesler, R. R. Patty, S. P. Reynolds, J. S. Risley, D. E. Sayers, J. F. Schetzina, P. J. Stiles;

Visiting Professors: J. L. Hubisz; *Adjunct Professors:* J. E. Rowe; *Professors Emeriti:* J. W. Cook Jr., W. R. Davis, W. O. Doggett, G. L. Hall, A. W. Jenkins Jr., K. L. Johnston, G. H. Katzin, E. R. Manring, J. D. Memory, J. Y. Park, L. W. Seagondollar, D. R. Tilley; *Associate Professors:* H. Ade, R. Beichner, J. M. Blondin, M. A. Klenin, G. W. Parker III, C. M. Roland; *Adjunct Associate Professors:* J. F. Shriner Jr.; *Assistant Professors:* J. D. Brown, H. Hallen, L. Mitas, M.

C. Sagui, A. R. Young; **Research Assistant Professors:** K. J. Borkowski, N. Dietz, J. H. Kelley;
Adjunct Assistant Professors: L. S. Plano

ASSOCIATE MEMBERS OF THE PROGRAM

Professors: J. Narayan, J. M. Danby, R. M. Kolbas, D. L. Ridgeway; **Adjunct Professors:** E. C. Theil; **Associate Professors:** L. K. Norris

Research opportunities are available in the following areas: astrophysics, atomic and molecular physics, condensed matter physics, nuclear physics and physics education.

Admission Requirements: Bachelor's degree in physics (or the equivalent) and the GRE Advanced test in physics.

Doctoral Degree Requirements: Six semesters beyond the baccalaureate; core physics courses PY 721, 781, 782, 783, 785, 786.

Student Financial Support: Graduate teaching assistantships are available for new and continuing students; research assistantships are normally available only to continuing students.

GRADUATE COURSES

- PY 501 Quantum Physics I.
- PY 502 Quantum Physics II.
- PY 506 Nuclear and Subatomic Physics.
- PY 507 Elementary Particle Physics.
- PY 508 Ion and Electron Physics.
- PY 509 Plasma Physics.
- PY 511 Mechanics I.
- PY 512 Mechanics II.
- PY 514 Electromagnetism I.
- PY 515 Electromagnetism II.
- PY 516 Physical Optics.
- PY 517 Atomic and Molecular Physics.
- PY 525 Computational Physics.
- PY(NE) 528 Introduction to Plasma Physics and Fusion Energy.
- PY 543 Astrophysics.
- PY(ECE) 552 Introduction to the Structure of Solids.
- PY 561 Electronics for Physicists.
- PY(MA) 575 Mathematical Introduction to Celestial Mechanics.
- PY(MA) 576 Orbital Mechanics.
- PY 601 Seminar.
- PY 610 Special Topics.
- PY 615 Advanced Special Topics.
- PY 660 Advanced Placement Physics for Secondary School Teachers.
- PY 685 Master's Supervised Teaching.
- PY 693 Master's Supervised Research.
- PY 695 Master's Thesis Research.
- PY 696 Summer Thesis Research.
- PY 699 Master's Thesis Preparation.
- PY 711 Advanced Quantum Mechanics I.
- PY 712 Advanced Quantum Mechanics II.
- PY 721 Statistical Physics I.
- PY 722 Statistical Physics II.
- PY(ECE) 727 Semiconductor Thin Films Technology.
- PY 730 Nuclear Structure Physics I.

PY 753 Introduction to the Structure of Solids II.
PY 754 Properties of Surfaces and Interfaces.
PY 781, 782 Quantum Mechanics I, II.
PY 783 Advanced Classical Mechanics I.
PY 785, 786 Advanced Electricity and Magnetism I, II.
PY 801 Seminar.
PY 810 Special Topics.
PY 815 Advanced Special Topics.
PY 860 Advanced Placement Physics for Secondary School Teachers.
PY 885 Doctoral Supervised Teaching.
PY 890 Doctoral Preliminary Examination.
PY 893 Doctoral Supervised Research.
PY 895 Doctoral Dissertation Research.
PY 896 Summer Dissertation Research.
PY 899 Doctoral Dissertation Preparation.

Physiology

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Physiology	Y		Y		Y	

GRADUATE FACULTY

Director of Graduate Programs:

J. N. Petite, Box 7608, 515.5389, j_petite@ncsu.edu

Professors: G. W. Almond, B. P. Alston-Mills, R. A. Argenzio, G. T. Barthalmus, B. L. Black, J. T. Brake, V. L. Christensen, W. J. Croom Jr., F. W. Edens, K. L. Esbenshade, W. L. Flowers, R. M. Grossfeld, H. F. Heatwole, T. E. LeVere, N. C. Olson, W. D. Oxender, R. M. Petters, M. A. Qureshi, M. C. Roberts, R. M. Roe, T. D. Siores, C. V. Sullivan, C. Teng, H. A. Underwood Jr., T. G. Wolcott; **Professors Emeriti:** E. V. Caruolo, C. H. Hill, J. F. Roberts, D. E. Smith; **Associate Professors:** B. A. Breuhaus, G. S. Davis, C. E. Farin, J. E. Gadsby, S. L. Pardue, J. N. Petite, S. P. Washburn, M. D. Whitacre; **Assistant Professors:** R. J. Borski, P. W. Farin, S. L. Vivrette, C. S. Whisnant; **Research Assistant Professors:** A. T. Blikslager

The physiology faculty is an interdepartmental group drawn from the departments participating in the program. These departments include animal science, biochemistry, entomology, food animal and equine medicine, poultry science, psychology, veterinary anatomy, physiological sciences and radiology, and zoology. The program emphasizes the comparative approach implicit in this type of organization and is designed to prepare individuals for careers in research and teaching.

Experimental animals available cover a wide range, from insects and other invertebrates to large mammals.

Admission Requirements: Students entering the graduate program in physiology should have a bachelor's degree in a related biological or physical science. Undergraduate courses should include physiology, biochemistry, organic chemistry, calculus and physics. The Aptitude Test of the Graduate Record Examination is required, and the Advanced Tests in biology and chemistry are

desirable.

Master's Degree Requirements: On average, the M.S. degree requires two to three years.

Doctoral Degree Requirements: On average, completion of the Ph.D. degree requires five years.

Student Financial Support: Financial assistance for qualified students in the form of research assistantships, fellowships and traineeships is available through participating departments.

Other Relevant Information: The physiology program is jointly administered by the Colleges of Agriculture and Life Sciences and Veterinary Medicine. Graduate students enrolled as physiology majors are located in the department of their major professor and may participate in departmental activities.

GRADUATE COURSES

PHY(ZO) 503 General Physiology I.

PHY(ZO) 504 General Physiology II

PHY(ZO) 513 Comparative Physiology.

PHY 601 Seminar.

PHY(ZO) 602 Seminar in Biology of Reproduction.

PHY 610 Selected Topics.

PHY 620 Special Problems.

PHY 685 Master's Supervised Teaching.

PHY 690 Master's Examination

PHY 693 Master's Supervised Research.

PHY 695 Master's Thesis Research.

PHY 696 Summer Thesis Research.

PHY 699 Master's Thesis Preparation.

PHY(ANS) 702 Reproductive Physiology of Mammals.

PHY(PO,ZO) 724 Comparative Endocrinology.

PHY(CBS,JMM,MB,PO) 756 Immunogenetics.

PHY(ANS,NTR) 764 Comparative Physiology of the Digestive System.

PHY(ANS) 780 Mammalian Endocrinology.

PHY 801 Seminar.

PHY(ANS,CBS,ZO) 802 Seminar in Biology of Reproduction.

PHY 810 Selected Topics.

PHY 820 Special Problems.

PHY 885 Doctoral Supervised Teaching.

PHY 890 Doctoral Preliminary Examination.

PHY 893 Doctoral Supervised Research.

PHY 895 Doctoral Dissertation Research.

PHY 896 Summer Dissertation Research.

PHY 899 Doctoral Dissertation Preparation.

OTHER SUPPORTING COURSES AVAILABLE

Other supporting courses are available in biochemistry, biomathematics, biotechnology, cell biology, comparative biomedical sciences, entomology, genetics, immunology, microbiology, nutrition, pharmacology, poultry science, psychology, statistics, toxicology and zoology. Certain courses on the interface between physiology and engineering may be taken after consultation with advisor and the instructors concerned.

Plant Pathology

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Plant Pathology	Y		Y		Y	

GRADUATE FACULTY

O. W. Barnett Jr., *Head of the Department*

Director of Graduate Programs:

D. F. Ritchie, Box 7616, 515.6809, david_ritchie@ncsu.edu

Philip Morris Professor: T. A. Melton, III, P. B. Shoemaker

Professors: J. E. Bailey, O. W. Barnett Jr., D. M. Benson, R. I. Bruck, M. E. Daub, R. A. Dean, L. F. Grand, J. Huang, S. A. Lommel, J. W. Moyer, C. H. Opperman, G. A. Payne, D. F. Ritchie, R. C. Rufty, H. D. Shew, T. B. Sutton, C. G. Van Dyke; **Research Professors:** S. Leath; **Professors (USDA):** A. S. Heagle; **Professors Emeriti:** J. L. Apple, C. W. Averre III, R. Aycock, K. R. Barker, D. F. Bateman, M. K. Beute, G. V. Gooding Jr., R. K. Jones, L. T. Lucas, C. E. Main, R. D. Milholland, N. T. Powell, J. P. Ross, J. N. Sasser, H. W. Spurr Jr., H. H. Triantaphyllou, J. C. Wells, N. N. Winstead; **Associate Professors:** D. M. Bird, M. Cubeta, E. L. Davis, B. C. Haning, P. B. Lindgren, J. B. Ristaino; **Associate Professors (USDA):** M. L. Carson, R. G. Upchurch; **Assistant Professors:** G. J. Holmes, S. Hu, F. J. Louws

ASSOCIATE MEMBERS OF THE PROGRAM

Professors: E. B. Cowling, J. M. Davis, W. M. Hagler, Jr.; **Associate Professors:** C. L. Hemenway

Plant pathology is committed to solving plant disease problems with research that focuses on plant-pathogen interactions at the genomic, cellular, organismal and ecological levels. Approaches include disease management, epidemiology, molecular biology and host-parasite interactions. Focus areas are bacteriology, mycology, nematology, virology, soil-borne pathogens and mechanisms of pathogenesis.

Admission Requirements: The general application procedures of the Graduate School noted at the beginning of this section are followed. Normally domestic, but not international, applicants are required to submit GRE results. A detailed statement of applicant interests and goals in plant pathology is most useful to the admissions committee.

Master's Degree Requirements: Required courses include: PP 501, PP(CS,IIS) 502, PP(MB) 503, PP 504, PP 505 and PP 506 plus one advanced course. Students serve as a teaching assistant for one course.

Doctoral Degree Requirements: A diagnostic examination prior to enrollment is used as a guide to course selection and to measure competency in the M.S. courses listed above. In addition, students take PP 809 Colloquium, PP 801 Seminar and two advanced courses. Students serve as a teaching assistant for two courses.

Student Financial Support: A limited number of one-half time assistantships are available on a competitive basis. Benefits include in-state tuition, out-of-state tuition waver and health insurance as covered under the Graduate School's 'Graduate Student Support Plan.' Applicants are considered for assistantship support at time of application. Special supplements to assistantships are available on a competitive basis for outstanding students.

Other Relevant Information: Fully equipped and staffed laboratories for research are available in addition to greenhouse facilities and environmental growth chambers in the phytotron. Special facilities for experimental work on diseases under field conditions are available at 16 locations throughout the state. Microcomputers, library, mycological herbarium, photography laboratory and interdepartmental electron microscopy center are additional features available in the department.

GRADUATE COURSES

PP 500 Plant Disease: Principles, Diagnosis and Management.

PP(BO,MB) 501 Fungi and Their Interaction with Plants.

PP(CS,HS) 502 Plant Disease: Methods and Diagnosis.

PP(MB) 503 Bacteria and Their Interactions with Plants.

PP 504 Plant Nematology.

PP 505 Introductory Plant Virology.

PP 506 Epidemiology and Plant Disease Control.

PP(BO,MB) 575 Introduction to Mycology.

PP 590 Special Topics.

PP 601 Seminar.

PP 610 Special Topics.

PP 615 Advanced Special Topics.

PP 620 Special Problems.

PP 685 Master's Supervised Teaching.

PP 690 Master's Examination.

PP 693 Master's Supervised Research.

PP 695 Master's Thesis Research.

PP 696 Summer Thesis Research.

PP 699 Master's Thesis Preparation.

PP 708 History of Phytopathology.

PP 720 Morphology and Taxonomy of Nematodes.

PP 724 Advanced Plant Nematology.

PP 725 Molecular Biology of Plant Viruses.

PP 726 Botanical Epidemiology.

PP 728 Soilborne Plant Pathogens.

PP 729 Plant Pathogenesis.

PP(BO,GN,MB) 730 Fungal Genetics and Physiology.

PP 732 Genetics of Host-Parasite Interactions.

PP(CS,GN,HS) 748 Breeding for Pest Resistance.

PP(BO,MB) 775 The Fungi.

PP(BO,MB) 776 The Fungi - Lab.

PP 790 Special Topics.

PP 801 Seminar.

PP 809 Colloquium in Plant Pathology.

PP 810 Special Topics.

PP 815 Advanced Special Topics.

PP 820 Special Problems.

PP 885 Doctoral Supervised Teaching.
PP 890 Doctoral Preliminary Examination.
PP 893 Doctoral Supervised Research.
PP 895 Doctoral Dissertation Research.
PP 896 Summer Dissertation Research.
PP 899 Doctoral Dissertation Preparation.

Poultry Science

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Poultry Science			Y		Y	

GRADUATE FACULTY

G. B. Havenstein, *Head of the Department*

Director of Graduate Programs:

M. A. Qureshi, Box 7608, 515.5388, m_qureshi@ncsu.edu

William Neal Reynolds Professor: W. E. Donaldson

Professors: J. T. Brake, V. L. Christensen, W. J. Croom Jr., F. W. Edens, J. D. Garlich, W. M. Hagler Jr., G. B. Havenstein, J. F. Ort, C. R. Parkhurst, M. A. Qureshi, B. W. Sheldon, J. C. H. Shih, T. D. Siopes, M. J. Wineland; *Adjunct Professors:* M. R. Bakst, W. L. Bryden, R. R. Dietert, K. K. Krueger, K. A. Schat; *Professors Emeriti:* T. A. Carter, E. W. Glazener, P. B. Hamilton, J. R. Harris, C. H. Hill; *Associate Professors:* K. E. Anderson, G. S. Davis, P. R. Ferket, J. L. Grimes, S. L. Pardue, J. N. Petite; *Assistant Professors:* D. K. Carver, P. E. Mozdziak, C. M. Williams; *Adjunct Assistant Professors:* T. F. Middleton

ASSOCIATE MEMBERS OF THE PROGRAM

Professors: R. W. Bottcher, P. A. Curtis; *Associate Professors:* D. P. Wages

Course offerings and research programs are comprehensive in the areas of physiology, nutrition, microbiology, molecular biology, immunology, genetics, pathology and toxicology. The demand for men and women with advanced training in poultry science is far greater than the supply. Opportunities exist for graduates in research and teaching in universities, government and private industry.

Admission Requirements: Exceptions to the minimum 3.00 undergraduate grade point average may be made for students with special backgrounds, abilities and interests.

Master's Degree Requirements: While there are no specific course requirements for the master's degree in poultry science, most programs exceed the minimum 30 credit hours.

Doctoral Degree Requirements: Doctoral degrees are offered only through interdepartmental programs in the disciplines of physiology, nutrition, genetics, toxicology, microbiology and immunology. Associated research is done with domestic birds in the Department of Poultry Science. Requirements are as given in the Graduate Catalog. Application should be made directly to the specific discipline program.

Student Financial Support: Both research and teaching assistantships are available on a competitive basis within the department. General requirements for these assistantships are as described in the Graduate Catalogue. Other financial support may be available in the form of graduate stipend supplementation, out-of-state tuition waivers or research grant support.

Other Relevant Information: The Department of Poultry Science occupies new facilities in a three-story building on the main campus library. The department consists of about 25 faculty, a support staff of approximately 50, 20 to 30 graduate students and postdoctoral associates, and 70-100 undergraduate students.

GRADUATE COURSES

PO 601 Seminar
PO 620 Special Problems
PO 685 Master's Supervised Teaching.
PO 693 Master's Supervised Research.
PO 695 Master's Thesis Research.
PO 696 Summer Thesis Research.
PO 699 Master's Thesis Preparation.
PO 702 Biotechniques in Avian Biology.
PO 705 Physiological Aspects of Poultry Management.
PO(PHY,ZO) 724 Comparative Endocrinology.
PO(CBS,IMM,MB,PHY) 756 Immunogenetics.
PO(IMM) 757 Avian Immunology.
PO(ANS,NTR) 775 Mineral Metabolism.
PO 801 Seminar.
PO 820 Special Problems.
PO 885 Doctoral Supervised Teaching
PO 893 Doctoral Supervised Research.
PO 895 Doctoral Dissertation Research.
PO 896 Summer Dissertation Research.
PO 899 Doctoral Dissertation Preparation.

Psychology

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Psychology	Y					

GRADUATE FACULTY

D. W. Martin, *Head of the Department*

Director of Graduate Programs:

D. H. Mershon, Box 7801, 515.1724, don_mershon@ncsu.edu

Professors: L. E. Baker-Ward, J. W. Cunningham, D. W. Drewes, W. P. Erchul, D. O. Gray, T. M. Hess, J. W. Kalat, T. E. LeVere, J. E. R. Luginbuhl, D. W. Martin, D. H. Mershon, J. J. Michael, R. W. Nacoste, S. E. Newman, F. J. Smith, B. W. Westbrook; **Adjunct Professors:** J. L. Howard, W. E. Schlenger, W. W. Tornow; **Professors Emeriti:** K. L. Barkley, J. C. Johnson, H. G. Miller, P. W. Thayer; **Associate Professors:** C. C. Brookins, S. A. Converse, A. G. Halberstadt, M. E. Haskett, P. F. Horan, K. W. Klein, S. B. Pond III, A. C. Schulte, S. S. Snyder, M. A. Wilson, M. S. Wogalter; **Adjunct Associate Professors:** B. B. Burrus, B. F. Corder, A. D. Hall, M. G. Sanders; **Associate Professors Emeriti:** J. L. Cole; **Assistant Professors:** M. Y. Bingham, P. W. Collins, R. E. Mitchell; **Visiting Assistant Professors:** D. J. Holden; **Adjunct Assistant Professors:** B. H. Beith, J. W. Fleenor, C. L. Kronberg, C. E. Lorenz, B. H. Rogers

ASSOCIATE MEMBERS OF THE PROGRAM

Professors: C. D. Korte; **Assistant Professors:** E. N. Wiebe

The Department of Psychology offers five courses of study leading to the Ph.D.: developmental psychology, ergonomics and experimental psychology, human resource development, industrial/organizational and vocational psychology, and school psychology.

Admission Requirements: Applicants should have satisfactory grades in all undergraduate work and at least a "B" average in undergraduate psychology courses, satisfactory scores on the GRE including the Advanced Test in psychology and three satisfactory letters of recommendation. The Miller Analogies Test is also recommended. Match of applicants' research interests with current faculty research is also considered.

Master's Degree Requirements: Specific course requirements vary by area. Typical programs will include from 36 to 55 hours. The M.S. degree is available as part of work toward the doctorate, but students wishing to obtain a terminal M.S. are advised to consider other programs.

Doctoral Degree Requirements: The graduate program for each doctoral student is determined in conjunction with the student's graduate advisory committee and tailored to the needs, interests, and accomplishments of the individual. Students can expect to take from 36 to 54 hours of credit beyond the master's degree.

Student Financial Support: Many graduate students receive financial support in the form of teaching or research assistantships. Applicants should request such support when they apply to the program.

GRADUATE COURSES

PSY 500 Visual Perception.

PSY 502 Physiological Psychology.

PSY(WGS) 506 Psychology of Gender.

PSY 508 Cognitive Processes.

PSY 511 Advanced Social Psychology.

PSY 510 Advanced Problems in Psychology

PSY 513 Psychology and Law.

PSY(PHI) 525 Introduction to Cognitive Science.
PSY 553 Principles and Practice of Ecological/community Psychology.
PSY 558 Psychology and the African Experience.
PSY 582 Adolescent Development.
PSY 584 Advanced Developmental Psychology.
PSY 591 History and Systems of Psychology.
PSY 596 Advanced Educational Psychology.
PSY 620 Special Problems in Psychology
PSY 641 Psychological Clinic Practicum.
PSY 651 Internship in Psychology.
PSY 680 Directed Study in Psychology.
PSY 685 Master's Supervised Teaching.
PSY 693 Master's Supervised Research.
PSY 695 Master's Thesis Research.
PSY 696 Summer Thesis Research.
PSY 699 Master's Thesis Preparation.
PSY 700 Audition and Other Non-visual Senses.
PSY 703 Biological Factors in Abnormal Behavior.
PSY 704 Learning and Motivation.
PSY 710 Special Topics in Psychology.
PSY 712 Attitudes.
PSY 713 Attribution.
PSY 714 Social Psychology: Small Groups Research.
PSY 720 Psychological Survey Operations.
PSY 721 Area Seminar in School Psychology.
PSY 722 Individual Intelligence Measurement.
PSY 723 Personality Measurement.
PSY 724 Psychological Intervention I.
PSY 725 Psychological Intervention II.
PSY 727 Psychological Consultation.
PSY 732 Theories of Intelligence.
PSY(IE) 740 Human Factors in Systems Design.
PSY(IE) 743 Ergonomic Performance Assessment.
PSY(IE) 744 Human Information Processing.
PSY(IE) 745 Human Performance
PSY 750 Area Seminar in Human Resources Development.
PSY 751 Human Resource Planning.
PSY 752 Action Research in Psychology.
PSY 755 Cross-cultural Research and Development
PSY 756 Consumer Research.
PSY 757 Innovation and Technology: A Socio-technical Perspective.
PSY 535 Tests and Measurements.
PSY 761 Psychological Measurement.
PSY 762 Quasi-experimental Evaluation Design.
PSY 763 Systems Theory and Applications in Human Resource Development.
PSY 764 Survey of Industrial/Organizational Psychology.
PSY 765 Vocational Psychology.
PSY 766 Personnel Selection Research.
PSY 767 Training Research.
PSY 768 Organizational Psychology.
PSY 769 Work Motivation.
PSY 770 Organization Development and Change.
PSY 785 Methodological Issues in Developmental Psychology.
PSY 786 Cognitive Development.
PSY 787 Social Development.
PSY 788 Adulthood and Aging: Cognitive and Intellectual Change.
PSY 789 Socio-emotional Processes in Adulthood and Aging.
PSY 792 Psychology of Families and Parenting.
PSY 795 Stress and Coping.
PSY 800 Introduction to Graduate Study in Psychology.
PSY(IE) 802 Area Seminar in Ergonomics.
PSY 807 Advanced Seminar in Research Design.

PSY 809 Psychology Colloquium.
PSY 820 Special Problems in Psychology.
PSY 825 Advanced Problems in Perception.
PSY 826 Advanced Problems in Cognition.
PSY 841 School Psychology Practicum.
PSY 846 Practicum in Industrial/Organizational Psychology.
PSY 851 Internship in Psychology.
PSY 880 Directed Study in Psychology.
PSY 885 Doctoral Supervised Teaching.
PSY 890 Doctoral Preliminary Examination.
PSY 893 Doctoral Supervised Research.
PSY 895 Doctoral Dissertation Research.
PSY 896 Summer Dissertation Research.
PSY 899 Doctoral Dissertation Preparation.

Public Administration

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Public Administration	Y				Y	

GRADUATE FACULTY

Director of Graduate Programs:

E. O'Sullivan, Box 8102, 515.5070, elizabethann_osullivan@ncsu.edu

Professors: D. M. Daley, M. S. Soroos, D. W. Stewart, J. H. Svara; **Associate Professors:** E. O'Sullivan, J. E. Swiss, M. L. Vasu; **Visiting Assistant Professors:** S. K. Straus

Administrative specialties are available in the following areas: administration of justice, association/ non-profit management, data management, environmental policy and management, financial management, human resource management and urban/local government management. The first doctoral program in public administration in N.C. providing advanced education in the field of public management, the Ph.D. is intended to prepare students for teaching and research in public management and related fields and as research specialists in governmental agencies and public affairs research institutes.

Admission Requirements: Since a limited number of pre-service students (i.e., those without professional or managerial work positions) are admitted, applicants to the M.P.A. program are encouraged to submit all materials by May 15 in order to receive full consideration. Admission to the doctoral program normally requires the completion of the M.P.A. or other relevant graduate degree. Applicants are encouraged to submit all materials as soon as possible to assure consideration for teaching assistantships, and although applications will be accepted through June 1, decisions regarding admission and assistantships will depend on availability of space and resources. Admission decisions are made on April 1, May 15 and July 1.

Master's Degree Requirements: The MPA degree is a 40-semester-hour program consisting of several overlapping tiers: (1) prerequisites to program admission including a course in economics

and an intermediate-level course in statistics; (2) a core curriculum of 17 hours; (3) a choice of administrative specialties based on courses in public administration and other departments; and (4) an internship or field experience requirement for pre-service students. It is an option B with a one-person committee and no final oral examination.

Doctoral Degree Requirements: Entering students will complete the core courses in the M.P.A. program (or equivalent courses from other institutions) along with a graduate-level statistics course as prerequisites to the program. Fifty-four hours beyond the master's degree including the dissertation and research seminars (including PA 761, PA 762, PA 763, PA 764) and courses in methodology/statistics (including PA 765, PA 766) are required.

Student Financial Support: A limited number of fellowships and graduate assistantships are offered by the department. Contact the department for more information. Other forms of student aid are described in the financial aid section of the Graduate Bulletin. Students interested in financial assistance should apply by April 1.

Other Relevant Information: The MPA program regularly conducts an Assessment Center to enhance students' skills in oral communication, technical writing and group dynamics. It is required for pre-service students. Activities include technical writing evaluations, evaluations of oral presentation skills and in-basket exercises to measure interpersonal, problem-solving and managerial skills. These exercises enable students to gain valuable training beyond their academic experience.

GRADUATE COURSES

- PA 501 Effective Writing for Public Managers.
- PA 509 Applied Political Economy.
- PA 510 Ethics and Professional Practice.
- PA 511 Public Policy Analysis.
- PA 512 The Budgetary Process.
- PA 513 Seminar in Organization Theory
- PA 514 Management Systems
- PA 515 Research Methods and Analysis.
- PA 520 Seminar in Urban Management.
- PA 521 Government and Planning.
- PA 522 Intergovernmental Relations in the United States.
- PA 525 Organization Design.
- PA 530 Financial Management in the Public Sector.
- PA 531 Seminar in Public Personnel Management.
- PA 535 Team Building for Public Managers.
- PA 536 Management of Non-profit Organizations.
- PA 537 Association Management.
- PA 540 Computer Applications in Public Affairs.
- PA 541 Geographic Information Systems for Public Administration.
- PA 545 Administrative Law
- PA 550 Environmental Policy.
- PA 555 Administration of Justice.
- PA 598 Special Topics.
- PA 602 Oral Presentation for Public Managers.
- PA 610 Special Topics.
- PA 635 Readings and Research.
- PA 640 Grantwriting.
- PA 650 Internship in Public Affairs.
- PA 660 Public Management Computing Lab.
- PA 685 Master's Supervised Teaching
- PA 701 Politics and Ethics of Public Administration.

PA 716 Seminar in Program Evaluation.
PA 721 Environmental Administration.
PA 732 Collective Negotiations in the Public Service.
PA 761 Foundations of Public Administration.
PA 762 Public Organization Theory.
PA 763 Public Policy Process.
PA 764 Budgeting and Financial Management.
PA 765 Quantitative Research in Public Administration.
PA 766 Advanced Research Methodology.
PA 770 Contemporary Public Management.
PA 780 Independent Study.
PA 810 Special Topics.
PA 835 Readings and Research.
PA 851 Internship in Public Affairs.
PA 860 Public Management Computing Lab.
PA 880 Directed Study.
PA 885 Doctoral Supervised Teaching.
PA 890 Doctoral Preliminary Examination.
PA 893 Doctoral Supervised Research.
PA 895 Doctoral Dissertation Research.
PA 896 Summer Dissertation Research.
PA 899 Doctoral Dissertation Preparation.

Public History

For a listing of graduate faculty and program information, see history.

School Administration

For a listing of graduate faculty and program information, see educational research, leadership and counselor education.

Science Education

For a listing of graduate faculty and program information, see mathematics, science and technology education.

Sociology

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Sociology	Y		Y		Y	

GRADUATE FACULTY

Director of Graduate Programs:

B. J. Risman, Box 8107, 515.9013, barbara_risman@ncsu.edu

Graduate Alumni Distinguished Professor: M. D. Schulman

William Neal Reynolds Professor: L. B. Otto, R. C. Wimberley

Professors: W. B. Clifford II, L. R. Della Fave, V. A. Hiday, T. J. Hoban, J. C. Leiter, T. T. McKinney, R. L. Moxley, B. J. Risman, D. Tomaskovic-Devey, E. M. Woodrum, M. A. Zahn, M. T. Zingraff; *Professors Emeriti:* E. M. Crawford, T. N. Hobgood Jr., C. P. Marsh, M. M. Sawhney, M. E. Voland, J. N. Young; *Associate Professors:* M. P. Atkinson, R. F. Czaja, S. K. Garber, T. N. Greenstein, S. C. Lilley, P. L. McCall, A. L. Schiller, M. L. Schwalbe, M. Thomas, M. S. Thompson, R. J. Thomson, K. M. Troost, M. L. Walek, J. M. Wallace III, C. R. Zimmer; *Adjunct Associate Professors:* J. F. Thigpen; *Associate Professors Emeriti:* R. C. Brisson, A. C. Davis, J. G. Peck; *Assistant Professors:* S. M. De Coster, R. S. Ellovich, R. L. Engen, W. R. Smith; *Assistant Professors Emeriti:* C. G. Dawson, T. M. Hyman

ASSOCIATE MEMBERS OF THE PROGRAM

Professors: R. D. Mustian

The department offers master's and doctoral programs in sociology designed to prepare students for academic, research, and applied careers. The programs are structured to provide an intellectually stimulating and academically rigorous, yet supportive, environment that emphasizes developing research skills through course work and close collaboration with faculty.

Admissions Requirements: In addition to general Graduate School requirements, applicants are required to provide a writing sample. For fall admission, the completed application should be received no later than February 1 to ensure full consideration for assistantship support; final deadline for fall admission is April 15. Applications for spring admission are considered under special circumstances, but assistantship support is less likely; final deadline for spring admission is November 1.

Master's Degree Requirements: Applicants should have received/be receiving a bachelor's degree from an accredited institution with a major in sociology. Other majors are considered, but students may have to make up deficiencies without credit. The M.S. requires a thesis, whereas a Master of Sociology (M.SOC.) requires six semester credit hours of practicum (supervised field placement in an organization or agency) and a research paper. A minor for both degrees is

optional.

Doctoral Degree Requirements: The Ph.D. normally requires a master's in sociology, at least 14 courses (including or after the master's). Doctoral students take core courses in theory and methods/analysis and select courses in two areas of specialization. Some course work from the master's may be applied. A minor is optional.

Student Financial Support: Teaching and research assistantships are available on a competitive basis.

GRADUATE COURSES

- SOC 505 Medical Technology.
- SOC 508 Social Organization.
- SOC 509 Population Problems
- SOC 513 Community Organization and Development.
- SOC 514 Developing Societies.
- SOC 520 Sociology of Religion.
- SOC 533 The Community.
- SOC 601 Seminar.
- SOC 610 Special Topics in Sociology.
- SOC 642 Practicum in Sociology.
- SOC 685 Master's Supervised Teaching.
- SOC 690 Master's Examination.
- SOC 693 Master's Supervised Research.
- SOC 695 Master's Thesis Research.
- SOC 696 Summer Thesis Research.
- SOC 699 Master's Thesis Preparation.
- SOC 701 Classical Sociological Theory.
- SOC 702 Contemporary Sociological Theory.
- SOC 703 Theory Construction.
- SOC 707 Quantitative Sociological Analysis.
- SOC 708 Advanced Sociological Analysis.
- SOC 711 Research Methods in Sociology I.
- SOC 712 Advanced Survey Research Methods.
- SOC 713 Applied Research.
- SOC 715 Qualitative Sociological Methods and Analysis.
- SOC 721 Deviant Behavior.
- SOC 722 Social Control.
- SOC 723 Research on Crime and Deviance.
- SOC 724 Crime and Collective Action.
- SOC 727 Comparative Societies.
- SOC 728 Social Systems and Planned Change.
- SOC 731 Survey of Family Sociology
- SOC 732 Contemporary Family Theory and Research.
- SOC 736 Social Stratification.
- SOC(WGS) 737 Sociology of Gender.
- SOC 738 Race and Ethnic Inequality.
- SOC(WGS) 739 Social Psychology of Inequality.
- SOC 742 Social-Psychological Processes in Health and Illness.
- SOC 743 Psychiatric Sociology and Mental Health.
- SOC 744 Health Behavior and Interventions.
- SOC 746 Sociological Social Psychology
- SOC 747 Social Psychology.
- SOC 752 Work and Industry
- SOC 753 Formal Organizations.
- SOC 754 Economic Sociology.
- SOC 756 Sociological Analysis of Agricultural Development
- SOC 757 Sociology of U.S. agriculture.

SOC 758 Rural Sociology.
SOC 762 Urban Ecology.
SOC 800 Professional Seminar.
SOC 801 Seminar.
SOC 810 Special Topics.
SOC 885 Doctoral Supervised Teaching.
SOC 890 Doctoral Preliminary Examination.
SOC 893 Doctoral Supervised Research.
SOC 895 Doctoral Dissertation Research.
SOC 896 Summer Dissertation Research.
SOC 899 Doctoral Dissertation Preparation.

Soil Science

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Soil Science	Y		Y		Y	

GRADUATE FACULTY

J. L. Havlin, *Head of the Department*

Director of Graduate Programs:

R. L. Mikkelsen, Box 7619, 513.3033, robert_mikkelsen@ncsu.edu

William Neal Reynolds Professor: S. W. Buol, J. W. Gilliam

Professors: A. Amoozegar, S. W. Broome, D. K. Cassel, J. L. Havlin, S. C. Hodges, M. T. Hoover, G. D. Hoyt, L. D. King, H. J. Kleiss, G. S. Miner, C. D. Raper Jr., W. P. Robarge, T. J. Smyth, M. J. Vepraskas, M. G. Waggoner, A. G. Wollum II, J. P. Zublena; *Professors (USDA):* D. W. Israel; *Professors Emeriti:* W. V. Bartholomew, F. R. Cox, G. A. Cummings, R. W. Cummings, W. A. Jackson, E. J. Kamprath, C. B. McCants, P. A. Sanchez, R. J. Volk, S. B. Weed; *Associate Professors:* D. L. R. Hesterberg, R. A. McLaughlin, R. L. Mikkelsen, G. C. Naderman Jr.; *Associate Professors Emeriti:* J. P. Lilly; *Assistant Professors:* D. A. Crouse, C. R. Crozier, D. L. Lindbo, D. L. Osmond, J. W. Rideout, J. G. White; *Assistant Professors Emeriti:* C. K. Martin

ASSOCIATE MEMBERS OF THE PROGRAM

Professors: H. L. Allen, Jr., G. F. Peedin, R. W. Skaggs, T. L. Grove, R. Lea, J. B. Weber

Graduate students in soil science may specialize in the following subdisciplines: soil physics, soil chemistry; soil microbiology and biochemistry; soil fertility and plant nutrition; soil genesis, morphology and classification; soil and water management and conservation; forest soils, soil mineralogy; tropical soil management.

Admissions Requirements: Graduate students accepted in soil science must have a bachelor or

master's degree with a major in soil science or a closely related field and with a strong background in the biological and physical sciences.

Master's Degree Requirements: A minor is optional, although one-third of the credits should usually be in courses outside of the department.

Doctoral Degree Requirements: A minor is optional, although one-third of the credits should usually be in courses outside of the department.

Student Financial Support: The department has a number of assistantships available to students who have demonstrated a high level of academic aptitude or potential. Most of the graduate assistantships are half-time.

GRADUATE COURSES

SSC 511 Soil Physics.

SSC 521 Soil Chemistry.

SSC 532 Soil Microbiology.

SSC 541 Soil Fertility.

SSC 551 Soil Morphology, Genesis and Classification.

SSC 562 Environmental Applications of Soil Science.

SSC 570 Wetlands Soils.

SSC(BAE) 573 Hydrologic and Water Quality Modeling.

SSC(CS,FOR) 577 Conservation and Sustainable Development I: Concepts and Methods.

SSC(FOR) 578 Conservation and Sustainable Development II: Integrated Problem Solving.

SSC(FOR) 581 Agroforestry.

SSC 601 Seminar.

SSC 609 Colloquium.

SSC 620 Special Problems.

SSC 685 Master's Supervised Teaching.

SSC 690 Master's Examination.

SSC 693 Master's Supervised Research.

SSC 695 Master's Thesis Research.

SSC 696 Summer Thesis Research.

SSC 699 Master's Thesis Preparation.

SSC 701 Tropical Soils: Characteristics and Management.

SSC 720 Soil and Plant Analysis.

SSC 721 Soil Chemistry.

SSC 722 Advanced Soil Chemistry.

SSC(CS,HS,TOX) 725 Pesticide Chemistry.

SSC(CS,HS,TOX) 727 Pesticide Behavior in Soil and Water.

SSC(MB) 732 Soil Microbiology.

SSC 753 Soil Mineralogy.

SSC 760 Advanced Soil Management.

SSC(BAE) 771 Theory of Drainage - Saturated Flow.

SSC 772 Soil Properties and Plant Development.

SSC(FOR) 773 Forest Productivity: Edaphic Relationships.

SSC(BAE) 774 Theory of Drainage - Unsaturated Flow.

SSC(BAE) 780 Transport and Fate of Chemicals in Soils and Natural Waters.

SSC(FOR) 782 Silviculture and Management of Forest Plantations in the Tropics.

SSC 801 Seminar

SSC 809 Colloquium.

SSC 820 Special Problems.

SSC 885 Doctoral Supervised Teaching.

SSC 890 Doctoral Preliminary Examination.

SSC 893 Doctoral Supervised Research.

SSC 895 Doctoral Dissertation Research.

Special Education

For a listing of graduate faculty and program information, see curriculum and instruction.

Special Education, Behavior Disorders

For a listing of graduate faculty and program information, see curriculum and instruction.

Special Education, Learning Disabilities

For a listing of graduate faculty and program information, see curriculum and instruction.

Special Education, Mental Retardation

For a listing of graduate faculty and program information, see curriculum and instruction.

Specialized Veterinary Medicine

For a listing of graduate faculty and program information, see comparative biomedical sciences.

Statistics

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Statistics	Y		Y		Y	

GRADUATE FACULTY

T. M. Gerig, *Head of the Department*

Director of Graduate Programs:

S. G. Pantula, Box 8203, 515.1949, dsgp@stat.ncsu.edu

Graduate Alumni Distinguished Professor: B. B. Bhattacharyya

William Neal Reynolds Professor: B. S. Weir

Professors: R. L. Berger, P. Bloomfield, D. D. Boos, C. Brownie, M. Davidian, D. A. Dickey, E. J. Dietz, T. M. Gerig, F. G. Giesbrecht, M. L. Gumpertz, T. Johnson, J. F. Monahan, S. G. Pantula, K. H. Pollock, D. L. Ridgeway, D. L. Solomon, L. A. Stefanski, W. H. Swallow, A. A. Tsiatis;

Research Professors: S. Zeng; **Adjunct Professors:** J. C. Brocklebank, J. R. Chromy, R. B. Conolly, J. H. Goodnight, P. D. Haaland, N. L. Kaplan, D. W. Nychka, E. A. Thompson, S. S. Young; **Professors Emeriti:** H. J. Gold, A. H. Grandage, R. J. Hader, R. J. Monroe, L. A. Nelson, C. H. Proctor, C. P. Quesenberry, J. O. Rawlings, R. G. Steel, H. R. Van Der Vaart, J. L. Wasik, O. Wesler; **Associate Professors:** J. M. Hughes-Oliver, T. W. Reiland, C. E. Smith, J. L. Thorne; **Adjunct Associate Professors:** J. M. Hoenig; **Associate Professors Emeriti:** A. C. Linnerud; **Assistant Professors:** S. R. Browning, T. C. Elston, M. Fuentes, M. G. Genton, S. K. Ghosh, T. B. Kepler, S. R. Lubkin, S. V. Muse, D. Zhang; **Research Assistant Professors:** D. M. Nielsen; **Adjunct Assistant Professors:** M. G. Ehm

ASSOCIATE MEMBERS OF THE PROGRAM

Professors: W. R. Atchley, M. M. Goodman, A. R. Hall, M. W. Suh; **Associate Professors:** T. H. Emigh

Admission Requirements: The written statement should describe the applicant's academic and career goals as well as special interests in the area of statistics. GRE General Test scores are required. The well-prepared applicant to the department's master's programs has good grades in a three-semester calculus sequence, a two-semester advanced calculus sequence, a semester of linear algebra and a two-semester sequence in probability and statistics. Some of these courses may be taken as part of the program, but this may result in lengthening the stay. Admission to the Ph.D. program is granted to those who have been admitted to the master's program and have passed the basic comprehensive (qualifying) examination at the Ph.D. level. Individuals applying for fall enrollment and who wish to be considered for financial aid should have their completed applications in by no later than March 1 for fall enrollment or October 15 for spring. Applications arriving after that will be considered but may be assigned lower priority.

Master's Degree Requirements: All master's programs in statistics require a minimum of 34 credit hours, of which 12 are first-year core (ST 512R, ST 521, ST 522, ST 552 and their labs), one is supervised consulting (ST 641), and at least nine are statistics and/or supporting electives. The remaining 12 hours are program dependent.

Doctoral Degree Requirements: The Ph.D. program in statistics requires 22 course credit hours beyond the master's, of which 12 are Ph.D. core (ST(MA) 778, 779, ST 793 and ST 794), one is supervised consulting (ST 841), six are Ph.D.-level statistics electives, and three are supporting electives. Requirements for co-majors are individually tailored.

Student Financial Support: Departmental assistantships and fellowships are awarded each year on a competitive basis. Fellowships and supplements are provided through the department's Gertrude M. Cox Fellowship Fund. Approximately 30 teaching assistantships and 30 research assistantships and traineeships are available along with several graduate industrial traineeships supported by local industries. In addition, the department offers NSF-VIGRE traineeships to qualified U.S. students.

Other Relevant Information: With a large graduate faculty representing virtually all major statistical specializations, the department is recognized as a world leader in graduate education and research in statistics. Its applied orientation sets it apart from most other departments in the country, offering education to those wishing to pursue careers as consulting statisticians in industry and government, as well as to those seeking careers in research and teaching.

Areas of research specialization of the faculty and advanced graduate students include spatial statistics, time series, econometrics, statistical genetics and ecology, experiment design and analysis, sampling, environmental applications, statistical process and quality control, biostatistics, biomathematics, bioinformatics, statistical computing, nonparametric regression, robust and nonparametric inference, mathematical programming, Bayesian inference, multivariate analysis, decision theory and stochastic processes.

The department has excellent computation facilities consisting of two computing laboratories: the Statistics Instructional Computing Laboratory (SICL), used for instruction and course labs, and the Statistics Research Computing and Information System (SRCIS), a research facility maintained for the use of statistics graduate students.

GRADUATE COURSES

- ST 505 Applied Nonparametric Statistics.
- ST(ZO) 506 Sampling Animal Populations.
- ST 507 Statistics for the Behavioral Sciences I.
- ST 508 Statistics for the Behavioral Sciences II.
- ST 511 Experimental Statistics for Biological Sciences I.
- ST 512 Experimental Statistics for Biological Sciences II.
- ST 513 Statistics for Management I
- ST 514 Statistics for Management and Social Sciences II.
- ST 515 Experimental Statistics for Engineers I.
- ST 516 Experimental Statistics for Engineers II.
- ST 520 Statistical Principles of Clinical Trials and Epidemiology.
- ST 521 Statistical Theory I.
- ST 522 Statistical Theory II.
- ST 524 Statistics in Plant Science.
- ST 535 Statistical Process Control.
- ST 536 Off-line Quality Control.
- ST(MA) 546 Theory of Probability I.
- ST 552 Linear Models and Variance Components.
- ST(ECG) 561 Intermediate Econometrics.
- ST 590 Special Topics
- ST 601 Seminar.
- ST 610 Topics in Statistics.
- ST 620 Special Problems.
- ST 625 Advanced Special Problems.
- ST 630 Independent Study.
- ST 635 Readings.
- ST 641 Statistical Consulting
- ST 685 Master's Supervised Teaching.
- ST 690 Master's Examination.
- ST 693 Master's Supervised Research.
- ST 695 Master's Thesis Research.
- ST 696 Summer Thesis Research.
- ST 699 Master's Thesis Preparation.
- ST(MA,OR) 706 Nonlinear Programming.
- ST 708 Applied Least Squares.
- ST 711 Design of Experiments.
- ST 714 Life-testing and Reliability.
- ST 715 Theory of Sampling Applied to Survey Design.
- ST(GN) 721 Genetic Data Analysis.
- ST(BMA,OR) 722 Decision Analytic Modeling.
- ST 730 Applied Time Series Analysis.
- ST 731 Applied Multivariate Statistical Analysis.
- ST 732 Applied Longitudinal Data Analysis.

ST 733 Applied Spatial Statistics.
ST 744 Categorical and Censored Data Analysis.
ST 745 Analysis of Survival Data.
ST(MA) 746 Introduction to Stochastic Processes.
ST(MA) 747 Probability and Stochastic Processes II.
ST(MA) 748 Stochastic Differential Equations.
ST 750 Statistical Computing.
ST(ECG) 751 Econometrics.
ST(ECG) 752 Topics in Econometrics.
ST 755 Advanced Analysis of Variance and Variance Components.
ST(GN) 756 Computational Molecular Evolution.
ST(BI,GN) 757 Statistics for Molecular Quantitative Genetics.
ST 760 Advanced Topics in Construction and Analysis of Experimental Designs.
ST 762 Nonlinear Statistical Models for Univariate and Multivariate Response.
ST(GN) 770 Statistical Concepts in Genetics.
ST(BMA,MA) 771 Biomathematics I
ST(BMA,MA) 772 Biomathematics II.
ST(BMA,MA,OR) 773 Stochastic Modeling.
ST(MA) 778, 779 Measure Theory and Advanced Probability I, II.
ST 782 Time Series Analysis: Time Domain.
ST 783 Time Series Analysis: Frequency Domain.
ST 784 Multivariate Analysis.
ST 785 Introduction to Statistical Decision Theory.
ST 790 Advanced Special Topics.
ST 793 Advanced Statistical Inference I.
ST 794 Advanced Statistical Inference II.
ST 801 Seminar.
ST 820 Special Problems.
ST 825 Advanced Special Problems.
ST 841 Statistical Consulting.
ST 885 Doctoral Supervised Teaching.
ST 890 Doctoral Preliminary Examination.
ST 893 Doctoral Supervised Research.
ST 895 Doctoral Dissertation Research.
ST 896 Summer Dissertation Research.
ST 899 Doctoral Dissertation Preparation

Technical Communication

For a listing of graduate faculty and program information, see English.

Technology Education

For a listing of graduate faculty and program information, see For a listing of graduate faculty and program information, see mathematics, science and technology education.

Textile and Apparel, Technology and Management

For a listing of graduate faculty and program information, see textile and apparel management.

Textile and Apparel Management

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Textile and Apparel, Technology and Management			Y		Y	

GRADUATE FACULTY

T. J. Little, *Head of the Department*

Director of Graduate Programs:

G. L. Hodge, Box 8301, 515.6579, george_hodge@ncsu.edu

Professors: R. A. Barnhardt, N. L. Cassill, R. A. Donaldson, A. H. M. El-Shiekh, T. J. Little, W. Oxenham, B. Pourdeyhimi, M. W. Suh; **Visiting Professors:** J. L. Woo; **Adjunct Professors:** R. W. Dent; **Professors Emeriti:** G. A. Berkstresser III, M. H. M. Mohamed, W. C. Stuckey Jr., S. C. Winchester Jr.; **Associate Professors:** P. Banks-Lee, T. K. Ghosh, H. H. A. Hergeth, G. L. Hodge, C. L. Istook, A. M. Seyam, G. W. Smith; **Visiting Associate Professors:** P. D. F. Kilduff; **Adjunct Associate Professors:** N. A. Hunter, P. E. Sasser, D. Shiffler; **Associate Professors Emeriti:** P. B. Hudson, M. L. Robinson Jr.; **Assistant Professors:** M. R. Jones, T. A. May-Plumlee, K. Thoney; **Visiting Assistant Professors:** C. G. Carrere; **Research Associates:** H. A. Davis

ASSOCIATE MEMBERS OF THE PROGRAM

Professors: S. K. Batra

The Department of Textile and Apparel, Technology and Management offers the degree of Master of Science in Textiles with specializations in textile technology management and textile technology and the professional degree of Master of Textiles. The department specializes in the disciplines of textile management, apparel management, textile technology, textile design, integrated manufacturing systems, textile marketing, quality control and modeling of the textile and apparel pipeline. Fundamental research in yarn and fabric mechanics, machine monitoring and material properties is also conducted in the department.

Admission Requirements: Students applying to this department should have or be able to develop strong quantitative skills. Students interested in management areas should have background in market analysis, quantitative management and quality management. Students should have a minimum of 24 course hours in advanced mathematics and sciences in their undergraduate degree.

Master's Degree Requirements: The M.S. in textiles with specializations in textile technology management and textile technology requires a minimum of 36 course hours to be composed of 15 credit hours from a core of courses in textile technology and textile management, nine credit hours in supporting courses (minor), two credit hours from graduate seminar, six credit hours of

research, with the remaining four hours from courses, research or "special projects." The non-thesis Master of Textiles requires a minimum of 33 credit hours (at least nine taken in supporting (minor) courses).

Student Financial Support: Financial aid in the form of assistantships may be available for full-time Master of Science students.

Other Relevant Information: The Department of Textile and Apparel Technology and Management currently houses the National Science Foundation's Center for Nonwoven Technology. This Centers allows students to conduct research in new technologies for nonwoven fabric manufacture. Participation in the National Textile Center allows students to conduct research in a variety of management, manufacturing, technology and engineering applications.

GRADUATE COURSES

TT(TE) 520 Yarn Processing Dynamics.

TT(TE,TMS) 521 Filament Yarn Production Processing and Properties.

TT(TE, TTM) 530 Textile Quality and Process Control.

TT(TE) 541 Theory and Practice of Knitted Fabric Production and Control.

TT(TE) 549 Warp Knit Engineering and Structural Design.

TT(TE) 550 Production Mechanics and Properties of Woven Fabrics.

TT 551 Advanced Woven Fabric Design and Structures.

TT 581 Technical Textiles.

TT 591 Special Studies in Textile Technology.

TT 601 Seminar.

TT 630 Independent Study in Textile Technology.

TT 676 Special Projects in Textile Technology.

TT 685 Master's Supervised Teaching.

TT 690 Master's Examination.

TT 693 Master's Supervised Research.

TT 695 Master's Thesis Research.

TT 696 Summer Thesis Research.

TT 699 Master's Thesis Preparation.

TT(FPS,TE) 720 Yarn Production/Properties: Advanced Topics.

TT(FPS,TE) 721 Total Quality Management in Textiles.

TT(FPS) 750 Advances in Woven Fabric Formation and Structure.

TTM 501 Textile Enterprise Integration.

TTM 502 Supervisory Control and Data Acquisition Systems for Textile Manufacturing.

TTM(TE) 531 Total Quality Management in Textiles.

TTM 561 Strategic Technology Management in the Textile Complex.

TTM(BUS) 585 Market Research in Textiles.

TTM 586 Advanced Textile Labor Management Seminar.

TTM 591 Special Studies in Textile Technology Management.

TTM 601 Seminar.

TTM 630 Independent Study in Textile Technology Management.

TTM 676 Special Projects in Textile Technology Management.

TTM 685 Master's Supervised Teaching.

TTM 690 Master's Examination.

TTM 693 Master's Supervised Research.

TTM 695 Master's Thesis Research.

TTM 699 Master's Thesis Preparation.

TTM(FPS) 761 Supply Chain Management and Information Technology in the Textile Complex

TTM 786 Advanced Textile Labor Management Seminar.

TTM 787 Competitive Strategy and Planning for the Textile Firm.

Textile Chemistry

For a listing of graduate faculty and program information, see textile engineering, chemistry and science.

Textile Engineering

For a listing of graduate faculty and program information, see textile engineering, chemistry and science.

Textile Engineering, Chemistry and Science

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Textile Chemistry			Y			
Textile Engineering			Y			
Textile Materials Science			Y		Y	

GRADUATE FACULTY

K. R. Beck, *Head of the Department*

Director of Graduate Programs:

H. S. Freeman, Box 8301, 515.6552, harold_freeman@ncsu.edu

Burlington Industries Professor of Textile Technology: R. L. Barker

Hoechst Trevira Professor of Polymer Chemistry: A. E. Tonelli

Professors: K. R. Beck, D. R. Buchanan, T. G. Clapp, A. H. M. El-Shiekh, A. B. Godfrey, P. L. Grady, B. S. Gupta, S. M. Hudson, C. D. Livengood, G. N. Mock, J. P. Rust, C. B. Smith, M. H. Theil; *Adjunct Professors:* R. F. Goldman; *Professors Emeriti:* P. D. Emerson, D. S. Hamby, S. P. Hersh, P. R. Lord, C. Tomasino, W. K. Walsh; *Associate Professors:* H. Hamouda, P. J. Hauser, W. J. Jasper, J. W. Rucker; *Adjunct Associate Professors:* L. D. Claxton; *Associate Professors Emeriti:* T. G. Rochow; *Assistant Professors:* D. Hinks, J. A. Joines, R. E. Kotek, M. G. McCord, Y. Qiu

ASSOCIATE MEMBERS OF THE PROGRAM

Professors: R. A. Barnhardt, S. K. Batra, R. A. Donaldson, R. E. Fornes, H. G. Olf, W. Oxenham; *Associate Professors:* P. Banks-Lee, T. K. Ghosh, R. J. Spontak

Master of Science in Textile Chemistry (MS/TC): The M.S. in textile chemistry program offers unique educational and research opportunities in textile and polymer chemistry. Fundamentals of

chemistry, physics, and mathematical sciences are applied to solve polymer and textile wet processing problems. M.S. in Textile Engineering (MS/TE): The M.S. in textile engineering offers unique educational and research opportunities in machine, process and product design. Fundamentals of physics, engineering, and mathematical sciences are applied to textile-related problems.

Admission Requirements: (MS/TC): Applicants must have a physical science or engineering background, including physical chemistry and differential equations. Formal education in textile or polymer chemistry is desired but not required. (MS/TE): Applicants must have a physical science or engineering background including differential equations. A background in engineering mechanics, fluids, dynamics and control theory is highly recommended. Formal education in textile engineering or materials science is desired but not required.

Degree Requirements: (MS/TC): This degree requires 15 credit hours in textile chemistry, nine credit hours in a supporting area (minor), ten credit hours of research, and two semester credits from the College Seminar (TC 601). Additional course work may be substituted for part of the research credits. (MS/TE): This degree requires 15 credit hours in textile engineering/textile materials science, nine credit hours in a supporting area (minor), ten credit hours of research, and two semester credits from the College Seminar (TE or TMS 601). Additional course work may be substituted for part of the research credits.

Student Financial Support: Financial aid in the form of assistantships and fellowships is normally available for all full-time students.

Other Relevant Information: The department either houses or has access to all major analytical tools necessary to effect a quality research program covering a wide range of topics. It also houses state-of-the-art facilities for conducting research in fiber science and textile engineering. Close cooperation between College faculty and the fiber/textile and allied industries provides students with opportunities for learning and employment.

GRADUATE COURSES

- TC 530 The Chemistry of Textile Auxiliaries.
- TC(MAT) 561 Organic Chemistry of Polymers.
- TC 565 Polymer Applications and Technology.
- TC(TE,TMS) 589 Special Studies in Textile Engineering and Science.
- TC 601 Seminar.
- TC 630 Independent Study
- TC 685 Master's Supervised Teaching.
- TC 690 Master's Examination.
- TC 693 Master's Supervised Research.
- TC 695 Master's Thesis Research.
- TC 696 Summer Thesis Research.
- TC 699 Master's Thesis Preparation
- TC 704 Fiber Formation--Theory and Practice.
- TC 705 Theory of Dyeing.
- TC 706 Color Science.
- TC 707 Color Laboratory.
- TC 720 Chemistry of Dyes and Color.
- TC 721 Dye Synthesis Laboratory.
- TC 725 Dyeing Cellulose.
- TC(CH,MAT) 762 Physical Chemistry of High Polymers--Bulk Properties.
- TC(CHE) 769 Polymers, Surfactants and Colloidal Materials.
- TC 771 Polymer Microstructures, Conformations and Properties

TC(CH,MAT) 772 Physical Chemistry of High Polymers--Solution Properties.
TC(CHE) 779 Diffusion in Polymers.
TC 791 Special Topics in Textile Science.
TC(TE,TMS) 792 Special Topics in Fiber Science.
TE 501 Analysis and Design of Yarn Production Systems.
TE 502 Dynamics of Fabric Production Systems.
TE 505 Textile Systems and Control.
TE(TT) 520 Yarn Processing Dynamics.
TE(TMS,TT) 521 Filament Yarn Production Processing and Properties.
TE(TT,TTM) 530 Textile Quality and Process Control.
TE(TTM) 531 Total Quality Management in Textiles.
TE(TT) 550 Production Mechanics and Properties of Woven Fabrics.
TE 565 Textile Composites.
TE 566 Polymeric Biomaterials Engineering.
TE(TMS) 589 Special Studies in Textile Engineering and Science.
TE(TMS) 601 Seminar
TE(TMS) 602 Textile Technology Seminar
TE(TMS) 630 Independent Study
TE(TMS) 685 Master's Supervised Teaching.
TE(TMS) 690 Master's Examination.
TE(TMS) 693 Master's Supervised Research.
TE(TMS) 695 Master's Thesis Research.
TE(TMS) 696 Summer Thesis Research.
TE(TMS) 699 Master's Thesis Preparation.
TE 703 Group Research in Textiles
TE 705 Textile Instrumentation and Control Systems
TE(ECE,MAE, FPS) 717 Multivariable Linear Systems Theory.
TE(FPS,TT) 720 Yarn Production/Properties: Advanced Topics.
TE(FPS,TT) 781 Mechanics of Twisted Structures.
TE(FPS,TT) 782 Mechanics of Fabric Structures.
TMS 500 Fiber and Polymer Microscopy.
TMS(FPS) 761 Mechanical and Rheological Properties of Fibrous Material.
TMS(FPS,MAT) 762 Physical Properties of Fiber Forming Polymers, Fibers and Fibrous Structures.
TMS(FPS,MAT) 763 Characterization of Structure of Fiber Forming Polymers.
TMS(FPS,TE) 765 Textile Composites.

Textile Material Science

For a listing of graduate faculty and program information, see textile engineering, chemistry and science.

Textile Technology Management

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Textile Technology Mgmt	Y					

GRADUATE FACULTY

Director of Graduate Programs:

W. Oxenham, Box 8301, 515.6573, william_oxenham@ncsu.edu

Professors: R. A. Barnhardt, S. K. Batra, K. R. Beck, T. G. Clapp, R. A. Donaldson, A. H. M. El-Sheikh, S. Fang, P. L. Grady, B. S. Gupta, D. M. Holthausen Jr., S. M. Hudson, T. J. Little, C. D. Livengood, S. E. Margolis, W. Oxenham, J. P. Rust, C. B. Smith, M. W. Suh; **Professors Emeriti:** G. A. Berkstresser III, J. R. Canada, S. P. Hersh, M. H. M. Mohamed, C. Tomasino, P. A. Tucker Jr.; **Associate Professors:** P. Banks-Lee, T. K. Ghosh, H. H. A. Hergeth, G. L. Hodge, J. W. Rucker, A. M. Seyam

Textile technology management is a multidisciplinary program designed to educate students for research careers in the management of technology in the fiber, textile, apparel and related industries complex. The program is designed to give the students a breadth of knowledge of the materials and technologies employed in the industries as well as the quantitative and analytical tools of management.

Admission Requirements: Students majoring in textiles; industrial, systems and manufacturing engineering; statistics; operations research; computer science; economics; consumer economics; marketing; and business administration, and having at least a 3.0/4.0 average in their undergraduate studies and a master's degree will normally qualify for admission. Exceptionally qualified students may be admitted directly without a master's degree.

Doctoral Degree Requirements: Fixed credit-hour requirements for the Doctor of Philosophy degree are 72. (Up to 18 hours from an M.S. may be applied against the 72.) Students are admitted to candidacy for the Ph.D. degree after passing two preliminary written and oral examinations (the first covering manufacturing technology and the second the management of technology) and orally defending a research proposal. They must also have passed an English technical writing course during their college career and, depending on the nature of their research interests, may also be required to demonstrate a reading knowledge of one foreign language.

Student Financial Support: Financial aid in the form of assistantships and fellowships is normally available for all full-time students.

Other Relevant Information: The College of Textiles has a 298,000 square-foot complex valued at over \$50 million which houses exceptional teaching, research, computer and library facilities. With a graduate faculty of 45 and research expenditures exceeding \$6,000,000 per year, opportunities abound. Facilities available to textile technology management students include: the Model Manufacturing Facility which contains over \$10,000,000 of textile processing equipment from fiber formation to end products; the IBM Computer Integrated Manufacturing (CIM) Facility which contains advanced technology computers running plant floor, supervisory monitoring and control, and manufacturing resource planning software packages; and the Textile Design Laboratory which contains several design packages which can communicate with plant floor devices providing CAD/CAM integration.

COURSE OFFERINGS (Extensive use may be made of graduate course offerings in other colleges on campus when developing the minor field. See departmental listing for descriptions.)

GENERAL COURSES

TTM 501 Textile Enterprise Integration.

TTM 502 Supervisory Control and Data Acquisition Systems for Textile Manufacturing

TTM 510 Apparel Technology Management.

TTM 515 Apparel Production.

TTM(TE,TT) 530 Textile Quality and Process Control.
TTM 561 Strategic Technology Management in the Textile Complex.
TTM 591 Special Studies in Textile Technology Management.
TTM 630 Independent Study in Textile Technology Management.
TTM 676 Special Projects in Textile Technology Management.
TTM(FPS,TT) 750 Advances in Woven Fabric Formation and Structure.
TTM 761 Supply Chain Management and Information Technology in the Textile Complex.
TTM 801 Seminar.
TTM 830 Independent Study.
TTM 876 Special Projects in Textile Technology Management.
TTM 885 Doctoral Supervised Teaching.
TTM 890 Doctoral Preliminary Examination.
TTM 893 Doctoral Supervised Research.
TTM 895 Doctoral Dissertation Research.
TTM 896 Summer Dissertation Research.
TTM 899 Doctoral Dissertation Preparation.

GRADUATE COURSES IN AREAS OF SPECIALIZATION

FPS(TE,TT) 781 Mechanics of Twisted Structures.
FPS(TE, TT) 782 Mechanics of Fabric Structures.
TMS(FPS,TE) 765 Textile Composites.
TT(TE) 520 Yarn Processing Dynamics.
TT(TE,TTM) 530 Textile Quality Control.
TT(TE) 541 Theory and Practice of Knitted Fabric Production and Control.
TT(TE) 549 Warp Knit Engineering and Structural Design.
TT(TE) 550 Production Mechanics and Properties of Woven Fabrics.
TT 589 Special Studies in Textile Technology.
TT 601 Seminar.
TT 630 Independent Study in Textile Technology.
TT(FPS,TE) 720 Yarn Production/Properties: Advanced Topics.
TT(FPS,TE) 721 Total Quality Management in Textiles.
TT(TE) 751, 752 Fabric Development and Construction.
TTM(TE) 531 Total Quality Management in Textiles.
TTM 583 Strategic Planning for Textile Firms.
TTM(BUS) 585 Market Research in Textiles.
TTM 591 Special Studies in Textile Technology Management.
TTM 601 Seminar
TTM 630 Independent Study in Textile Technology Management.
TTM 676 Special Projects in Textile Technology Management.
TTM 786 Advanced Textile Labor Management Seminar.

Toxicology

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Toxicology	Y		Y		Y	

GRADUATE FACULTY

Director of Graduate Programs:

G. A. LeBlanc, Box 7633, 515.7404, ga_leblanc@ncsu.edu

William Neal Reynolds Professor: E. Hodgson

Professors: G. A. LeBlanc, R. B. Leidy, R. C. Smart; **Adjunct Professors:** J. A. Bond, J. A. Goldstein, R. J. Langenbach, R. J. Preston; **Professors Emeriti:** T. J. Sheets; **Associate Professors:** D. Shea; **Adjunct Associate Professors:** A. E. Chalmers, N. Chernoff, K. M. Crofton, H. B. Matthews Jr., R. R. Miller, L. Recio; **Assistant Professors:** S. Branch, W. G. Cope; **Visiting Assistant Professors:** R. L. Rose

ASSOCIATE MEMBERS OF THE PROGRAM

Professors: K. B. Adler, J. E. Riviere, J. M. Cullen, H. M. Hassan, R. J. Kuhr, W. H. McKenzie, N. A. Monteiro-Riviere, M. A. Qureshi, R. M. Roe, M. K. Stoskopf; **Associate Professors:** I. W. Smoak; **Research Associate Professors:** J. M. Horowitz; **Assistant Professors:** J. M. Law

Admission Requirements: Prospective students should have a strong background in the biological and physical sciences with a minimum undergraduate grade point average of 3.0 (on a 4.0 scale) in the biological and physical sciences.

Master of Science Degree Requirements: A minimum of 30 credit hours with at least 20 credit hours of graduate-level courses. A thesis is required.

Master of Toxicology Degree Requirements: A minimum of 14 credit hours in TOX courses are required. While a thesis is not required, at the discretion of the student's advisory committee, a review paper focusing on the student's interest in some aspect of toxicology might be required. The requirements, in all other respects, are the same as for the M.TOX. and M.S. degrees.

Doctoral Degree Requirements: A minimum of 39 credit hours plus dissertation research is required for the Ph.D. degree.

Student Financial Support: Financial assistance is available for qualified applicants through traineeships, fellowships, teaching assistantships and research assistantships with participating faculty members.

Other Relevant Information: Students pursuing either the M.S. or Ph.D. degree may elect to specialize in environmental toxicology or molecular and cellular toxicology. More details can be obtained on the departmental website: <http://cals.ncsu.edu/toxicology/index.htm>

GRADUATE COURSES

TOX 601 Seminar.
TOX 620 Special Problems in Toxicology.
TOX(ST) 621 Statistical Problems in Toxicology.
TOX 628 Principles of Reproductive and Developmental Toxicology Research
TOX(BCH) 660 Free Radicals in Toxicology
TOX 685 Master's Supervised Teaching.
TOX 690 Master's Examination.
TOX 693 Master's Supervised Research.
TOX 695 Master's Thesis Research.
TOX 696 Summer Thesis Research.
TOX 699 Master's Thesis Preparation

TOX 701 General Toxicology.
TOX 704 Chemical Risk Assessment.
TOX(IMM) 705 Immunotoxicology.
TOX 710 Biochemical Toxicology.
TOX 715 Environmental Toxicology.
TOX 721 Chemical Carcinogenesis.
TOX(ENT) 722 Insecticide Toxicology.
TOX(CS,HS,SSC) 725 Pesticide Chemistry.
TOX(CS,HS,SSC) 727 Pesticide Behavior and Fate in the Environment.
TOX 801 Seminar.
TOX 820 Special Problems.
TOX(BCH) 860 Free Radicals in Toxicology
TOX 885 Doctoral Supervised Teaching.
TOX 890 Doctoral Preliminary Examination
TOX 893 Doctoral Supervised Research.
TOX 895 Doctoral Dissertation Research.
TOX 896 Summer Dissertation Research.
TOX 899 Doctoral Dissertation Preparation.

COURSES FROM ASSOCIATED DEPARTMENTS

BCH 553 Metabolism and Molecular Biology.
BCH 701 Macromolecular Structure.
BCH 703 Macromolecular Synthesis and Regulation.
BCH 705 Molecular Biology of the Cell.
BCH 761 Advanced Molecular Biology of the Cell.
CBS 754 Principles of Epidemiology.
CBS 762 Systemic Pharmacology and Toxicology.
CBS 770 Cell Biology.
CBS 787 Pharmacokinetics.
GN 701 Molecular Genetics.
ST 501 Experimental Statistics for Biological Sciences I.
ZO 513 Comparative Physiology.
ZO 760 Principles of Ecology.

Training and Development

For a listing of graduate faculty and program information, see adult and community college education.

Wood and Paper Science

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Wood and Paper Science	Y		Y		Y	

GRADUATE FACULTY

M. J. Kocurek, *Head of the Department*

Director of Graduate Programs:

R. D. Gilbert, Box 8005, 515.7711, richard_gilbert@ncsu.edu

Elis and Signe Olsson Professor: J. S. Gratzl

Reuben B. Robertson Professor: H. Chang

Professors: J. Denig, J. A. Heitmann Jr., M. A. Hubbe, L. G. Jahn, H. Jameel, M. W. Kelly, M. J. Kocurek, H. G. Olf, E. A. Wheeler; **Research Professors:** J. S. Stewart; **Adjunct Professors:** L. L. Edwards, T. K. Kirk; **Professors Emeriti:** A. C. Barefoot Jr., E. L. Deal Jr., E. L. Ellwood, R. D. Gilbert, I. S. Goldstein, C. A. Hart, R. G. Pearson, R. J. Thomas; **Associate Professors:** B. Kasal, A. G. Kirkman, J. P. Roise, R. A. Venditti; **Adjunct Associate Professors:** R. B. Phillips; **Assistant Professors:** J. F. Kadla, P. H. Mitchell, P. N. Peralta; **Research Associates:** C. L. Chen

ASSOCIATE MEMBERS OF THE PROGRAM

Professors: E. B. Cowling

Course offerings and research facilities are available in the following areas: Wood chemistry, lignin and carbohydrate chemistry, pulping chemistry, process analysis, polymer chemistry, fiber and paper properties, secondary fiber studies, wood physics (especially wood liquid relations), wood anatomy, wood biology, wood mechanics and engineering, wood machining, manufacturing processes, wood-based industry economics and marketing.

Admission Requirements: Requirements listed here are in addition to graduate school requirements stated elsewhere. To be admitted, a student should have earned a B.S. degree with a major in wood and paper science or the equivalent. Graduates with other physical science or engineering baccalaureate degrees can be admitted but may be required to make up certain undergraduate deficiencies. Students with a 3.0 GPA and with appropriate course backgrounds will be considered for admission.

Master of Science Degree Requirements: In addition to Graduate School requirements, a minor is required.

Master of Wood and Paper Science Degree Requirements: The Master of Wood and Paper Science is a non-thesis, professional degree for students not interested in research. A minimum of 36 course credits is required. The regulations regarding credits are the same as for the M.S. degree except that up to 6 credits of 400-level courses in the major field may be included. A technical report which demonstrates the student's ability to gather, analyze and report information is required.

Doctoral Degree Requirements: In addition to Graduate School requirements, Ph.D. candidates must present two seminars before their final oral examination will be arranged.

Student Financial Support: A limited number of research assistantships are available.

Other Relevant Information: Graduate students should select a chairman and other advisory committee members and submit a plan of graduate work by the end of their first semester of residence. They are also urged to take the qualifying examinations within one year of residence. The department believes M.S. and Ph.D. students should select a research topic and begin their

thesis research as early as possible.

As the field of wood and paper science is a derived science, considerable emphasis is placed upon developing a strong minor in the graduate program in any one or more of the supporting disciplines such as organic chemistry, polymer chemistry, chemical engineering, mathematics, statistics, biology, engineering mechanics, mechanical engineering, physics, and economics or business administration.

Students in wood chemistry and pulp and paper programs must pass certain qualifying examinations.

GRADUATE COURSES

- WPS 527 Wet-end and Colloidal Chemistry.
- WPS(CE) 528 Structural Design in Wood
- WPS(MAE) 534 Mechatronics Design.
- WPS 591 Master's Seminar.
- WPS 601 Seminar.
- WPS 620 Special Problems.
- WPS 625 Advanced Wood and Paper Science Problems.
- WPS 685 Master's Supervised Teaching.
- WPS 690 Master's Examination.
- WPS 691 Methods of Research in Wood and Paper Science.
- WPS 693 Master's Supervised Research.
- WPS 695 Master's Thesis Research.
- WPS 696 Summer Thesis Research.
- WPS 699 Master's Thesis Preparation.
- WPS 704 Timber Physics.
- WPS 713 Tropical Woods
- WPS 715 Surface and Colloid Chemistry of Papermaking.
- WPS 721 Chemistry of Wood Polysaccharides.
- WPS 722 Chemistry of Lignin and Extractives.
- WPS 725 Pollution Abatement in Forest Products Industries
- WPS 733 Advanced Wood Anatomy.
- WPS 740 Wood Composites.
- WPS 750 Wastewater Treatment in the Paper Industry.
- WPS 760 Advanced Pulp and Paper Process Analysis.
- WPS 791 Doctoral Seminar.
- WPS 801 Seminar.
- WPS 820 Special Problems.
- WPS 825 Advanced Wood and Paper Science Problems.
- WPS 885 Doctoral Supervised Teaching.
- WPS 890 Doctoral Preliminary Examination
- WPS 691 Methods of Research in Wood and Paper Science
- WPS 893 Doctoral Supervised Research.
- WPS 895 Doctoral Dissertation Research.
- WPS 896 Summer Dissertation Research.
- WPS 899 Doctoral Dissertation Preparation.

Zoology

Degrees Offered:

Program Title	Ph.D.	Ed.D.	M.S.	M.A.	Master of	M.Ed.
Zoology	Y		Y		Y	

GRADUATE FACULTY

T. L. Grove, *Head of the Department*

Director of Graduate Programs:

B. J. Copeland, Box 7617, 515.4589, bj_copeland@ncsu.edu

Professors: R. R. H. Anholt, G. T. Barthalmus, B. L. Black, P. T. Bromley, B. J. Copeland, P. D. Doerr, J. F. Gilliam, W. C. Grant, R. M. Grossfeld, T. L. Grove, H. F. Heatwole, T. M. Losordo, C. F. Lytle, J. M. Miller, R. L. Noble, R. A. Powell, J. A. Rice, C. V. Sullivan, H. A. Underwood Jr., J. G. Vandenberghe; **Adjunct Professors:** F. A. Cross, L. B. Crowder, D. E. Hoss, G. R. Huntsman, P. Kelley, G. W. Thayer, J. R. Walters; **Professors Emeriti:** W. W. Hassler, G. C. Miller, T. L. Quay, J. F. Roberts, D. E. Smith; **Associate Professors:** H. V. Daniels, J. M. Hinshaw, R. G. Hodson, S. C. Mozley, M. N. Niedzlek-Feaver; **Associate Professors (USDI/USFS):** J. A. Collazo, J. E. Hightower, T. J. Kwak, T. R. Simons; **Adjunct Associate Professors:** W. J. Fleming, M. J. Groom, C. S. Manooch III, R. M. Shelley, H. W. van der Veer; **Assistant Professors:** R. J. Borski, J. Godwin, N. M. Haddad, P. S. Rand; **Adjunct Assistant Professors:** E. M. Bennett, A. E. Bogan, D. T. Cobb, W. E. Palmer, W. C. Starnes

ASSOCIATE MEMBERS OF THE PROGRAM

Professors: E. J. Jones, R. A. Lancia, K. H. Pollock, T. G. Wolcott

Areas of study include: cell biology and physiology, ecology and behavior, and fisheries and wildlife biology. Specializations within these areas include developmental biology, invertebrate biology, animal reproduction, biorhythms, behavioral ecology, population ecology, conservation biology, wildlife field studies, aquaculture and many others.

Admission Requirements: GRE scores (general) are required for admission. Biology Subject test recommended but not required. Regular admission requires an undergraduate grade point average of 3.0 in an appropriate biological discipline. Some research experience is highly recommended.

Master's Degree Requirements: M.S.: No more than six hours of temporary courses (ZO 624, ZO 824) or two hours of departmental seminar can be included in the 30-hour requirement for the M.S. Six hours of research credits (ZO 695) resulting in a thesis are required. A minor (usually 9-10 hours) is required. Master of Zoology: Of the 36 credit hours required, a minimum of four must be special problems and no more than two hours can be seminars. Other requirements may be imposed by the advisory committee.

Doctoral Degree Requirements: A student's advisory committee recommends appropriate courses which will provide a strong foundation in the student's area of interest. This typically includes 21-27 credit hours plus a minimum requirement of 10 hours of research (ZO 895) leading to a dissertation is required. A minor (usually 9-10 hours) is required.

Student Financial Support: Graduate teaching and research assistantships are available to well-qualified students.

Other Relevant Information: Students may also pursue degrees in interdepartmental programs in physiology and fisheries and wildlife biology. Excellent research facilities, equipment and computers are available. Field work can be conducted at nearby natural areas and laboratory work at various state and federal laboratories associated with the department.

GRADUATE COURSES

ZO 501 Ornithology.
ZO(PHY) 503 General Physiology I.
ZO(PHY) 504 General Physiology II.
ZO(ENT) 509 Ecology of Stream Invertebrates.
ZO 512 Animal Symbiosis.
ZO(PHY) 513 Comparative Physiology.
ZO(FW) 515 Fish Physiology.
ZO 519 Limnology.
ZO 522 Biological Clocks.
ZO 542 Herpetology.
ZO 544 Mammalogy.
ZO(MEA) 550 Principles of Biological Oceanography.
ZO(FW) 553 Principles of Wildlife Science.
ZO(FW) 554 Wildlife Field Studies.
ZO(MB) 555 Protozoology.
ZO 581 Helminthology.
ZO(ENT) 582 Medical and Veterinary Entomology.
ZO(FW) 586 Aquaculture I.
ZO(FW) 587 Aquaculture I Laboratory.
ZO 590 Special Topics.
ZO 592 Topical Problems
ZO 601 Seminar.
ZO(ANS,CBS,PHY) 602 Seminar in Biology of Reproduction.
ZO 603 Aquatic Ecology Seminar.
ZO 624 Topical Problems.
ZO 631 Special Studies.
ZO 660 Population Ecology.
ZO 685 Master's Supervised Teaching.
ZO 690 Master's Examination.
ZO 693 Master's Supervised Research.
ZO 695 Master's Thesis Research.
ZO 696 Summer Thesis Research.
ZO 699 Master's Thesis Preparation.
ZO(ST) 710 Sampling Animal Populations.
ZO 714 Advanced Cell Biology.
ZO 718 Community Ecology.
ZO 721 Fishery Science.
ZO(PHY,PO) 724 Comparative Endocrinology.
ZO 726 Quantitative Fisheries Management.
ZO(GN) 740 Evolutionary Genetics.
ZO(MEA) 750 Marine Benthic Ecology.
ZO(MEA) 754 Advances in Marine Community Ecology.
ZO(MEA) 756 Ecology of Fishes.

ZO(BO) 760 Principles of Ecology.
ZO(BO) 770 Advanced Topics in Ecology I.
ZO 784 Advanced Topics in the Study of Mammals.
ZO 789 Advanced Limnology.
ZO 790 Special Topics.
ZO 791 Topics in Animal Behavior.
ZO 792 Topical Problems.
ZO(ANS,CBS,PHY) 802 Seminar in Biology of Reproduction.
ZO 804 Seminar in Evolutionary Biology.
ZO 824 Topical Problems.
ZO 831 Special Studies.
ZO 885 Doctoral Supervised Teaching.
ZO 890 Doctoral Preliminary Examination.
ZO 893 Doctoral Supervised Research.
ZO 895 Doctoral Dissertation Research.
ZO 896 Summer Dissertation Research.
ZO 899 Doctoral Dissertation Preparation.

MINOR AND OTHER ORGANIZED PROGRAMS OF STUDY

Anthropology (Minor Program)

The anthropology minor requires a total of nine hours of anthropology course work with at least six of those hours having been taken at NC State. These courses must be taught by at least two different professors.

GRADUATE COURSES

ANT 508 Culture and Personality.
ANT 511 Anthropological Theory.
ANT 512 Applied Anthropology.
ANT 516 Introduction to Qualitative Research Methods.
ANT(WGS) 544 Cross-cultural Perspectives on Women.
ANT 610 Special Topics.
ANT 810 Special Topics.

Artificial Intelligence (Minor Program)

GRADUATE FACULTY

Professors: R. C. Luo, W. J. Rasdorf, H. E. Schaffer, A. L. Tharp; Associate Professors: D. R. Bahler, H. D. Levin, R. D. Rodman, E. T. Sanii; Lecturer: J. C. Sutton III

Artificial intelligence is the branch of computer science concerned with designing computer systems which exhibit the characteristics normally associated with intelligence in human behavior, such as understanding language, learning, reasoning, solving problems and so on. At NC State, artificial intelligence is an interdisciplinary field, with faculty from several departments engaged in fundamental research and applications.

The university offers courses of study leading to a minor in artificial intelligence as part of the M.S. and Ph.D. degrees. This option is available to all graduate students except those in computer science, who can choose artificial intelligence as an interest area.

To fulfill the academic requirements for a minor in artificial intelligence, each master's student must successfully complete at least three, and each doctoral student at least six, of the courses in the artificial intelligence curriculum. Two of the courses must be CSC 520, Artificial Intelligence I and CSC 720, Artificial Intelligence II. Other courses offered as part of the artificial intelligence curriculum include: CSC 523 Computational Linguistics; CSC 723 Computational Semantics; ECE 763 Computer Vision; CSC(IE) 556 Voice Input/Output Communication Systems; CSC(IE) 756 Advances in Voice Input/Output Communication Systems. Also, from time to time special topics courses are offered covering subjects such as knowledge engineering, fuzzy reasoning, knowledge representation, artificial intelligence applications to CAD, and artificial intelligence in manufacturing.

Graduate students in computer science who select artificial intelligence as an interest area are subject to the same academic requirements that define other interest areas within computer science.

Biological Sciences

There is no separate graduate major in the biological sciences, but both M.S. and Ph.D. degrees are offered in several life science departments and programs of the College of Agriculture and Life Sciences. Interdisciplinary courses applicable to several graduate programs are offered by the Biological Sciences Interdepartmental Program.

GRADUATE COURSE

BIO 510 Advanced Biology for Secondary Teachers

Biomedical Engineering (Minor Program)

GRADUATE FACULTY

Professors: C. F. Abrams, M. A. Ayoub, R. G. Carbonell, B. S. Gupta, J. J. Hren, C. Kleinstreuer, J. M. Mackenzie, T. K. Miller III, H. T. Nagle Jr., A. A. Nilsson, D. F. Ollis, H. G. Perros, S. A. Rajala, J. E. Smallwood, W. E. Snyder, L. Stikeleather, E. A. Stone, M. K. Stoskopf, D. E. Thrall, H. J. Trussell, T. G. Wolcott; Adjunct Professor: J. P. Archie; Professors Emeriti: F. M. Richardson, C. W. Suggs; Associate Professors: S. M. Blanchard, D. G. Bristol, R. D. Gould, L. C. Hudson, S. M. Hudson, R. E. Meyer, R. A. Powell, C. E. Smith, K. A. Spaulding; Assistant Professor: S. C. Roe

The biomedical engineering program provides graduate minors under the direction of faculty from fourteen departments in the Colleges of Agriculture and Life Sciences, Engineering, Natural Resources, Physical and Mathematical Sciences, Textiles and Veterinary Medicine at NC State. Faculty from the Biomedical Engineering Departments at Duke University and the University of North Carolina at Chapel Hill are also actively involved. Graduate students from all departments may elect a biomedical engineering minor. To fulfill the minor requirements, a student must take three courses in one of four specialty tracks: biomechanics, biofluids and biomaterials; biomedical modeling and signal processing; instrumentation, sensors and telemetry; medical imaging and communications systems.

The graduate faculty maintain lists of courses from which the students may make their selections. The particular choice of courses is left to the student and the student's advisory committee. A student may choose a minor outside one of the four tracks with the approval of the Biomedical Engineering Academic Affairs Committee. The courses for all biomedical engineering graduate minors must be distinctly different from the student's major field of study.

Students who elect the biomedical engineering graduate minor are encouraged to engage in research activities that involve interactions with faculty and students in other departments and/or colleges.

Biotechnology (Minor Program)

GRADUATE FACULTY

Professor R. M. Kelly, Director
Box 7512, (919) 515-4230, Fax (919) 151-4231, biotech@ncsu.edu
Home page: <http://www.ncsu.edu/biotechnology/>

The Biotechnology Program includes faculty from twenty departments in the Colleges of Agriculture and Life Sciences, Engineering, Natural Resources, Physical and Mathematical Sciences, and Veterinary Medicine. Graduate study leading to either an M.S. minor or a Ph.D. minor in biotechnology may be taken by students who reside and conduct their research in one of the participating departments. To obtain a minor in biotechnology, the student must successfully complete at least six credit hours in the laboratory core courses selected from the list below and must conduct graduate thesis research in an area of biotechnology.

Research in biotechnology is focused in three main areas: recombinant DNA technology, bioprocessing/bioanalytical techniques, and in vitro culture techniques. The multidisciplinary nature of biotechnology means that a wide range of research topics and techniques are applicable, such as molecular level genetics and associated research in molecular biology, enzyme technology and protein engineering, bioprocessing using cells or enzymes, development of biosensors, hybridoma technology, cell culture techniques and embryo manipulation.

See the biotechnology home page for a current listing of faculty.

GRADUATE COURSES

BIT 810 Core Technologies in Molecular and Cellular Biology.
BIT 815 Advanced Special Topics.

Business Management (Minor Program)

GRADUATE FACULTY

Professor S. H. Barr, Head
Professor S. G. Allen, Director of Graduate Programs

Professors: R. L. Clark, G. W. Dickson, C. P. Jones; Associate Professors: A. Agrawal, D. L. Baumer, S. N. Chapman, J. C. Dutton Jr., E. A. McDermed, K. Mitchell, A. Padilla, J. C.

Poindexter Jr., J. W. Wilson; Assistant Professors: L. Aiman-Smith, C. C. Bozarth, K. S. Davis, J. B. Earp, S. K. Markham, J. K. McCreery, P. W. Mulvey, M. Montoya-Weiss, K. D. Schenk, G. B. Voss, G. S. Young

The department offers a graduate minor in business management. Students enrolled in master's programs other than the Master of Science in Management may earn a minor by successfully completing nine hours of courses in the department at the 500 or 600 level. For a listing of courses in business management, see management.

Computational Engineering and Sciences (Minor Program)

GRADUATE FACULTY

Professor P. J. Turinsky, Program Coordinator

Professors: D. P. Agrawal, W. E. Alexander, H. T. Banks, J. Bernholc, S. R. Cotanch, R. E. Funderlic, C. K. Hall, C. Kleinstreuer, D. F. McAllister, D. S. McRae, T. K. Miller III, G. E. Mitchell, J. F. Monahan, H. G. Perros, R. O. Scattergood, W. J. Stewart, M. A. Vouk, M. H. Whangbo, R. E. White, J. L. Whitten; Associate Professors: J. W. Baugh, D. W. Brenner, J. M. Doster, J. E. Franke, E. F. Gehringer, C. R. Ji, S. E. Koch, Y.-L. Lin; Assistant Professor: T. M. Conte

The Computational Engineering and Sciences Program includes faculty from twelve departments in the College of Engineering and College of Physical and Mathematical Sciences. Graduate students pursuing graduate study toward a master's or Ph.D. degree in one of the participating science or engineering departments may elect this program in place of the traditional minor. [Note that students wishing to earn a graduate degree in mathematics or computer science should reference these departments' sections of the Graduate Catalog for details on options available in computational mathematics and scientific computing.] To complete the program requirements, a student must successfully complete a sequence of graduate-level applied mathematics and computer science courses and, if a research dissertation is required, utilize advanced computational techniques in the course of conducting the research.

The Computational Engineering and Sciences Program is designed to efficiently prepare graduate students to undertake research utilizing scientific computing by combining course work in applied mathematics and computer science in addition to course work in the traditional major. The program recognizes that a new area of scientific pursuit, numerical simulation, has emerged as a new paradigm for scientific inquiry complementing theory and laboratory experiment. Typical areas of research include, but are not limited to, computational fluid dynamics, quantum chemistry and atmospheric modeling. Admission to the program is gained after enrollment in the Graduate School and the graduate program is underway. Program course requirements are selected from applied mathematics and computer science courses listed elsewhere in this Graduate Catalog. To facilitate the satisfaction of prerequisite requirements for graduate-level computer science courses, CSC 489 is offered for graduate credit, combining the key contents of several undergraduate courses. Typical courses that may be selected to satisfy this program's requirements include advanced calculus, numerical analysis, numerical linear algebra for parallel architectures, stochastic simulation, computer operating systems, digital systems architecture, computer graphics, compiler construction, software engineering, and design and analysis of algorithms.

Education [General Courses]

GRADUATE COURSES

ED(AEE) 501 Foundations of Agricultural and Extension Education.
ED(AEE) 530 Priority Management in Agricultural and Extension Education.
ED(AEE) 641 Practicum in Agricultural and Extension Education.
ED(AEE) 735 Effective Teaching in Agriculture and Life Sciences.
ED(AEE) 841 Practicum in Agricultural and Extension Education.

Food Safety (Minor Program)

GRADUATE FACULTY

Professor D. R. Ward, Program Coordinator

Professors: K. Anderson, S. M. Blankenship, H. M. Hassan, T. J. Hoban, T. G. Isleib, B. W. Sheldon, D. R. Ward; Associate Professors: B. P. Alston-Mills, S. A. Hale, L.-A. Jaykus, W. E. M. Morrow; Assistant Professors: M. T. Correa, S. J. Libby, C. E. Sorenson

The purpose of the Food Safety Minor is to prepare science professionals with the breadth of training necessary to understand and address food safety challenges. The interdisciplinary minor includes departments in the Colleges of Agriculture and Life Sciences and Veterinary Medicine as well as the School of Public Health at the University of North Carolina at Chapel Hill.

Participating graduate students are required to have, or to develop during the early part of their training, appropriate knowledge in the basic scientific disciplines of chemistry, biochemistry and microbiology. Further, it is highly desirable that formal course training in genetics and statistics be, or become, evident in each student's academic program. Students in a master's program are required to have 10 credits from the core courses to earn the food safety minor. Students in a doctoral program are required to have, as a minimum, 10 credits from the core courses.

CORE COURSES

FSA(FS) 520 Pre-harvest Food Safety.
FSA(FS) 530 Post-harvest Food Safety.
FSA(FS) 540 Food Safety and Public Health.
FSA(FS) 580 Professional Development and Ethics in Food Safety.

Foreign Languages and Literatures

GRADUATE FACULTY

Professor L. R. Schehr, Head of the Department

Professors: G. F. Gonzalez, J. R. Kelly, M. L. Sosower, M. A. F. Witt; Professors Emeriti: A. A. Gonzalez, M. Paschal, G. W. Poland, E. M. Stack; Associate Professors: R. M. A. Alder, S. G.-Q. Alonso, V. Bilenkin, H. G. Braunbeck, G. A. Dawes, M. M. Magill, A. C. Malinowski, D. M. Marchi, L. Mykyta, M. L. Salstad; Associate Professors Emeriti: W. M. Holler, S. E. Simonsen, H. Tucker Jr.; Assistant Professors: J. M. Levis, J. P. Mertz, G. P. P. Meyjes

The Department of Foreign Languages and Literatures offers courses to assist graduate students in preparing to use modern foreign languages in research and advanced study. These courses are not open to undergraduates. With special permission of the Graduate School, certification may be obtained in languages not normally taught by the department.

The following courses are designed to be audited, and credits do not apply toward advanced degrees.

FLF 401 French for Graduate Students.

FLG 401 German for Graduate Students.

FLS 401 Spanish for Graduate Students.

Geographic Information Systems (Minor Program)

Geographic Information Systems (GIS) is the study of spatial distributions and relationships including display and analysis of spatial data in a visual context using maps, charts, etc. The GIS program offers a certificate program in Geographic Information Systems and two minors, one in Geographic Information Systems and one in Remote Sensing and Image Analysis. The objectives of the program include developing an internationally recognized graduate GIS instruction program, assistance in meeting the high demand for professional GIS analysts and providing a focus for expanding the university GIS research and instruction program. The certificate program consists of a minimum of 15 credits hours while the minor in GIS consists of 10 credit hours and the minor in Remote Sensing and Image Analysis, 12 credit hours. Currently, there are approximately 30 departments active in varying applications of spatial analysis within their respective fields, and this program give interested graduate students additional competency that should enhance job suitability. The certificate program and both minors are only available at the graduate level.

GRADUATE COURSES

NR(PRT) 531 Introduction to Geographic Information Science.

NR(PRT) 532 Principles of Geographic Information Science.

NR(PRT) 533 Application Issues in Geographic Information Systems.

NR(PRT) 535 Computer Cartography.

Multidisciplinary Studies

GRADUATE COURSES

MDS 595 Special Topics in Multidisciplinary Studies.

MDS 610 Special Topics.

MDS 685 Master's Supervised Teaching.

Philosophy

GRADUATE COURSES

PHI(PSY) 525 Introduction to Cognitive Science.

PHI 540 The Scientific Method.
PHI 635 Advanced Independent Study in Philosophy.
PHI 798 Advanced Topics in Philosophy.

Plant Physiology

GRADUATE FACULTY

Professor T. W. Rufty Jr., Coordinator
Box 7619, (919) 515-3660

Professors: N. S. Allen, S. M. Blankenship, W. F. Boss, W. S. Chilton, M. A. Conkling, F. T. Corbin, R. C. Fites, J. Huang, M. M. Peet, D. M. Pharr, C. D. Raper Jr, E. C. Sisler, S. L. Spiker, W. F. Thompson; Professors (USDA): E. L. Fiscus, S. C. Huber, D. W. Israel, R. F. Wilson; Associate Professors: H. V. Amerson, R. S. Boston, D. C. Bowman, J. D. Burton, S. D. Clouse, R. E. Dewey, G. P. Fenner, P. B. Lindgren, D. Robertson, R. Wells, R. Whetten; Associate Professors (USDA): K. O. Burkey, D. P. Livingston; Research Assistant Professor: J. D. Williamson

The plant physiology program is an interdepartmental offering. Although not a formal degree program, students may elect to major or minor in the plant physiology program at both the M.S. and Ph.D. levels. Students entering the program should have appropriate knowledge in plant biology, chemistry, mathematics and physics. Some formal training in genetics and statistics is normally expected.

When majoring in plant physiology, students will be closely affiliated with the same department as their major professor. As such, they will be required to meet respective departmental requirements for teaching, written and oral examinations, and seminar attendance. Departments currently participating in this program are: biochemistry, botany, crop science, forestry, genetics, horticultural science, plant pathology and soil science. The chair or co-chair of the student's advisory committee must be a member of the Plant Physiology Faculty.

The purpose of the plant physiology curriculum is to ensure that students obtain substantive understanding of the physiological processes controlling plant behavior. The course requirements for graduate students are set by each graduate committee. Advanced knowledge is expected in plant physiology, biochemistry, structure and function, and molecular biology. Acceptable achievement most often occurs with successful completion of the following courses:

- BO 751 Advanced Plant Physiology I
- BCH 610N Special Topics: Regulation of Intermediary Metabolism in Eucaryotes
- BO 780 Plant Molecular Biology
- BO 590C Topical Problems: Plant Cell Biology
 - or*
 - BO 795 Special Topics in Botany: Plant Form, Function and Development

The program is administered by the Plant Physiology Executive Committee. Additional information about the program may be obtained by writing to one of the listed faculty members or to the coordinator.

Religion

GRADUATE COURSE

REL(HI) 560 American Religion after Darwin.

Solid State Sciences (Minor Program)

GRADUATE FACULTY

University Professor G. Lucovsky, Chair

Professors: D. E. Aspnes, K. J. Bachmann, S. M. Bedair, J. Bernholc, R. F. Davis, R. E. Fornes, J. R. Hauser, J. J. Hren, M. A. Littlejohn, R. M. Kolbas, J. Narayan, R. J. Nemanich, M. A. Paesler, G. Rozgonyi, P. E. Russell, D. E. Sayers, J. F. Schetzina, A. F. Schreiner, E. O. Stejskal, M. H. Whangbo, J. J. Wortman

The university offers courses of study leading to a minor in solid state sciences as part of the M.S. and the Ph.D. degrees. This option is available to all graduate students pursuing research in the broad area of solid state science and requires that a member of the solid state sciences faculty serve on the student's research committee.

Solid state sciences is an interdisciplinary area of research that applies and extends concepts from the traditional academic disciplines of chemistry, electrical and computer engineering, materials science and engineering, and physics to basic and applied problems with a primary focus on solid state materials. At NC State, there are a significant number of such research programs that involve faculty and students in more than one of the academic departments listed above. This minor program can be customized to provide a course complement for these ongoing programs, as well as for any additional solid state materials research programs as they are initiated, developed and implemented.

To fulfill the academic requirements for a minor in solid state sciences, each master's student must successfully complete at least three, and each doctoral student, four of the courses in the solid states sciences curriculum. A partial listing of courses in this program includes: CH 701, 703 Advanced Inorganic Chemistry I, II; CH 731 Chemical Thermodynamics; CH 733 Chemical Kinetics; CH 737 Quantum Chemistry; ECE 730 Physical Electronics; ECE 739 Integrated Circuit Technology and Fabrication; ECE 723 Optical Properties of Semiconductors; ECE 724 Electronic Properties of Solid State Devices; ECE (PY) 727 Semiconductor Thin Films Technology; MAT 712 Scanning Electron Microscopy; MAT 715 Fundamentals of Transmission Electron Microscopy; MAT 560 Materials Science and Processing of Semiconductor Devices; MAT 795 Advanced Materials Experiments; MAT 722 Advanced Scanning Electron Microscopy and Surface Analysis; MAT 770 Defects, Diffusion and Ion Implantation in Semiconductors; MAT 792 Advanced Topics in Materials Science and Engineering; PY (ECE) 552 Introduction to the Structure of Solids. In addition, other courses (for example, special topics courses in any one of the participating departments) may also be substituted into an individual student's designated solid state sciences minor program at the discretion of his/her committee.

Water Resources (Minor Program)

WATER RESOURCES COMMITTEE

J. D. Gregory, Chair
Box 8008, (919) 515-7567, E-mail: jim_gregory@ncsu.edu

J. E. Parsons (Biological and Agricultural Engineering), J. M. Burkholder (Botany), M. R. Overcash (Chemical Engineering), R. C. Borden (Civil Engineering), J. B. Weber (Crop Science), R. B. Palmquist (Economics), F. P. Hain (Entomology), K. M. Keener (Food Science), S. R. Raval (Landscape Architecture), D. G. Evans (Marine, Earth and Atmospheric Sciences), J. W. Gilliam (Soil Science), C. B. Smith (Textile Engineering, Chemistry and Science), S. C. Mozley (Zoology)

The graduate minor in water resources is an interdisciplinary, interdepartmental minor that is designed to provide a specialization in water resources for students who are majoring in the many disciplines of natural resources, engineering, technology and social sciences that are related to or involve water management. The graduate minor in water resources will expose students to several different courses and faculty members in water resources that are outside his/her major field of study.

A graduate student may enroll in the water resources minor by including it on the plan of graduate work. A graduate faculty member from outside the student's major department or program must be appointed to serve as the minor representative on his/her advisory committee. The minor representative may be a member of the Water Resources Committee or another faculty member from a department represented on the Water Resources Committee who is active in teaching/research related to water resources. The minimum course requirements for a graduate minor in water resources are described below.

Master's Degree: Three courses (minimum of eight credit hours) from water resources areas outside the student's major field of study approved by the student's minor representative. Doctor of Philosophy Degree: Three courses (minimum of eight credit hours) from water resources areas outside the student's major field of study approved by the student's minor representative. These courses shall be in addition to those previously taken at the master's level when that degree included a Water Resources Minor. Recommended Course: A course in the legal, institutional, or economic aspects of water resources recommended for each minor program. Contact J. D. Gregory for a list of recommended courses.

Women's and Gender Studies (Minor Program)

GRADUATE FACULTY

Associate Professor L. R. Severin, Director

Professors: N. S. Allen, J. A. Anderson, J. Ferster, C. M. Pierce, T. H. Regan, B. J. Risman, L. R. Schehr, M. Scotford, J. D. Smith, D. Tomaskovic-Devey, M. A. Witt; Associate Professors: M. A. Atkinson, L. E. Baker-Ward, M. E. Barbercheck, H. G. Braunbeck, J. K. Cunningham, V. J. Gallagher, T. N. Greenstein, C. Gross, A. G. Halberstadt, D. Laryea, M. M. Magill, J. E Morrison, L. A. Mykyta, R. Leonard, M. E. Orr, E. O'Sullivan, J. O. Pettis, T. L. Robinson, M. L. Schwalbe, S. L. Spencer, M. S. Thompson, P. Tyler, C. R. Zimmer; Assistant Professors: R. S. Ellovich, C.

R. Haller, A. F. Khater, L. S. May, M. T. Pramaggiore, S. M. Setzer, K. Shepherd-Barr, S. M. Stein, C. Warren, S. T. Warren

The minor provides graduate students in the humanities, social sciences and sciences with the theories and the methodologies to study women and gender relations. The minor is intended to support and further students' research in their own field. Nine hours of graduate credit are required. Students may choose from the courses listed below and/or a list of approved special topics courses.

GRADUATE COURSES

WGS(ECD) 540 Gender Issues in Counseling.
WGS(ANT) Cross-cultural Perspectives on Women.
WGS(HI) 547 American Women to 1900.
WGS(HI) 548 American Women in the 20th Century.
WGS(PSY) 706 Psychology of Gender.
WGS(SOC) 737 Sociology of Gender.
WGS(SOC) 739 Social Psychology of Inequality.

Graduate Faculty

Abbate, Angelo Rudy, M.L.A., Professor, Landscape Architecture
Aboelfotoh, Mohamed O., Ph.D., Visiting Professor, Chemical Engineering
Abrams, Charlie Frank Jr., Ph.D., Professor, Biological and Agricultural Engineering
Abt, Robert C., Ph.D., Associate Professor, Forestry
Adams, Dewey Allen, Ed.D., Professor Emeritus, Mathematics, Science, and Technology Education
Ade, Harald, Ph.D., Associate Professor, Physics
Adler, Kenneth B., Ph.D., Graduate Alumni Distinguished Professor, Anatomy, Physiology, and Radiology
Agris, Paul F., Ph.D., Professor, Biochemistry
Aiman-Smith, Lynda, Ph.D., Assistant Professor, Business Management
Akroyd, H. Duane, Ph.D., Associate Professor, Adult and Community College Education
Alapaty, Kirankumar V., Ph.D., Adjunct Assistant Professor, Marine, Earth and Atmospheric Sciences
Alder, Ruth M. Ayend, Ph.D., Associate Professor Emeritus, Foreign Languages and Literatures
Alexander, Samuel Thomas, Ph.D., Associate Professor, Electrical and Computer Engineering
Alexander, Winser E., Ph.D., Professor, Electrical and Computer Engineering
Alibrandi, Marsha L., Ed.D., Assistant Professor, Curriculum and Instruction
Allen, Howard Lee Jr., Ph.D., Carl Alwin Schenck Professor, Forestry
Allen, Janice Benson, Ph.D., Research Assistant Professor, Anatomy, Physiology, and Radiology
Allen, Jonathan C., Ph.D., Professor, Food Science
Allen, Nina Stromgren, Ph.D., Professor, Botany
Allen, Steven G., Ph.D., Professor, Business Management
Allen, William D., Ph.D., Visiting Assistant Professor, Electrical and Computer Engineering
Almond, Glen W., Ph.D., Professor, Food Animal and Equine Medicine
Alonso, Silvia Gonzalez-Quevedo, Ph.D., Associate Professor Emeritus, Foreign Languages and Literatures
Alston-Mills, Brenda P., Ph.D., Professor, Animal Science
Altier, Craig, Ph.D., Assistant Professor, Microbiology, Pathology, and Parasitology
Alvarez, Raul, Professor Emeritus, Industrial Engineering
Amatya, Devendra M., Ph.D., Research Assistant Professor, Biological and Agricultural Engineering
Ambaras, Davis, Ph.D., Assistant Professor, History
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Vasu, Ellen Storey, Ph.D., Associate Professor, Curriculum and Instruction
Vasu, Michael Lee, Ph.D., Associate Professor, Political Science and Public Administration
Vaughan, George B., Ph.D., Professor, Adult and Community College Education
Venditti, Richard A., Ph.D., Associate Professor, Wood and Paper Science
Vepraskas, Michael John, Ph.D., Professor, Soil Science
Vergheese, Kuruvilla, Ph.D., Professor, Nuclear Engineering
Vickery, Kenneth Powers, Ph.D., Associate Professor, History
Vincent, Kenneth Steven, Ph.D., Professor, History
Vimiotis, Ioannis, Ph.D., Associate Professor, Electrical and Computer Engineering
Vivrette, Sally L., Ph.D., Assistant Professor, Food Animal and Equine Medicine
Vogel, Eric M., Ph.D., Adjunct Assistant Professor, Electrical and Computer Engineering
Voland, Maurice E., Ph.D., Professor Emeritus, Sociology and Anthropology
Volk, Richard James, Ph.D., Professor Emeritus, Soil Science
Vose, James M., Ph.D., Adjunct Associate Professor, Forestry
Voss, Glenn B., Ph.D., Assistant Professor, Business Management
Vouk, Mladen Alan Velimir, Ph.D., Professor, Computer Science
Vu, Ken V., Ph.D., Adjunct Assistant Professor, Electrical and Computer Engineering
Vukina, Tomislav, Ph.D., Associate Professor, Economics and Business
Wade, Robert W., Ph.D., Adjunct Assistant Professor, Parks, Recreation and Tourism Management
Wages, Dennis P., D.V.M., Associate Professor, Food Animal and Equine Medicine
Wagger, Michael Gary, Ph.D., Professor, Soil Science
Wahl, George Henry Jr., Ph.D., Professor, Chemistry
Wahls, Harvey Edward, Ph.D., Professor Emeritus, Civil Engineering
Waites, Cheryl, Ed.D., Professor, Food Science
Walberg, Gerald David, Ph.D., Professor Emeritus, Mechanical and Aerospace Engineering
Walden, Michael Leonard, Ph.D., Professor, Economics and Business
Waldvogel, Michael G., Ph.D., Visiting Assistant Professor, Entomology
Walek, Mary Louise, Ph.D., Associate Professor, Sociology and Anthropology
Walgenbach, James F., Ph.D., Professor, Entomology
Wall, John Nelson Jr., Ph.D., Professor, English

Wallace, James Macauley III, Ph.D., Associate Professor, Sociology and Anthropology
Walsh, William Kershaw, Ph.D., Professor Emeritus, Textile Engineering, Chemistry and Science
Walter, William M. Jr., Ph.D., Professor Emeritus, Food Science
Walters, Jeffrey Ray, Ph.D., Adjunct Professor, Zoology
Wang, Binghe, Ph.D., Associate Professor, Chemistry
Wang, Weiqiang, Ph.D., Assistant Professor, Mathematics
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Ward, Donna R., Ph.D., Professor, Food Science
Warren, Catherine A., Ph.D., Assistant Professor, English
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Warren, Stuart L., Ph.D., Professor, Horticultural Science
Waschka, Rodney A. II, D.M.A., Associate Professor, Multidisciplinary Studies
Washburn, Steven P., Ph.D., Associate Professor, Animal Science
Wasik, John Louis, Ed.D., Professor Emeritus, Statistics
Waters, William Meade Jr., Ph.D., Associate Professor, Mathematics, Science, and Technology Education
Watson, David Wesley, Ph.D., Assistant Professor, Entomology
Watson, Gerald Francis, Ph.D., Associate Professor, Marine, Earth and Atmospheric Sciences
Watson, Larry Wayne, Ed.D., Associate Professor, Mathematics, Science, and Technology Education
Wear, David N., Ph.D., Adjunct Assistant Professor, Forestry
Weber, Jerome Bernard, Ph.D., Professor, Crop Science
Wechsler, Monroe S., Ph.D., Adjunct Professor, Nuclear Engineering
Weed, Sterling Barg, Ph.D., Professor Emeritus, Soil Science
Weeks, Willard Wesley, Ph.D., Professor, Crop Science
Wehner, Todd Craig, Ph.D., Professor, Horticultural Science
Weir, Bruce Spencer, Ph.D., William Neal Reynolds Professor, Statistics
Weir, Robert John, Ph.D., Associate Professor, Forestry
Weisel, Deborah Lamm, Ph.D., Research Assistant Professor, Political Science and Public Administration
Weissinger, Arthur K., Ph.D., Professor, Crop Science
Weisz, P. Randall, Ph.D., Assistant Professor, Crop Science
Welby, Charles William, Ph.D., Professor Emeritus, Marine, Earth and Atmospheric Sciences
Weldon, Tracey L., Ph.D., Assistant Professor, English
Wellman, J. Douglas, Ph.D., Professor, Parks, Recreation and Tourism Management
Wells, J. C., M.S., Professor Emeritus, Plant Pathology
Wells, Randy, Ph.D., Professor, Crop Science
Welsch, Frank, Dr.Med.Vet., Adjunct Professor, Anatomy, Physiology, and Radiology
Wenig, Robert Emery, Ph.D., Associate Professor, Mathematics, Science, and Technology Education
Wentworth, Thomas Ralph, Ph.D., Professor, Botany
Werner, Dennis James, Ph.D., Professor, Horticultural Science
Wemssman, Earl Allen, Ph.D., William Neal Reynolds Professor, Crop Science
Wertz, Dennis William, Ph.D., Associate Professor, Chemistry
Wesler, Oscar, Ph.D., Professor Emeritus, Statistics
Wessels, Walter John, Ph.D., Associate Professor, Economics and Business
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Wilcut, John W., Ph.D., Associate Professor, Crop Science
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Wilkinson, Richard R., M.L.A., Professor, Landscape Architecture
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Williams, Paul F., Ph.D., Professor, Accounting
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Wolfram, Walter Andrew, Ph.D., William C. Friday Distinguished Professor, English
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Wollum, Arthur George II, Ph.D., Professor, Soil Science
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Woodrum, Eric M., Ph.D., Professor, Sociology and Anthropology
Worsham, Arch Douglas, Ph.D., Professor Emeritus, Crop Science
Wortman, Jimmie Jack, Ph.D., Professor, Electrical and Computer Engineering
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Wright, Jeffrey A., Ph.D., Adjunct Assistant Professor, Forestry
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Yamamoto, Yuri Takeshima, Ph.D., Research Assistant Professor, Forestry
Yelverton, Fred Hinnant, Ph.D., Assistant Professor, Crop Science
Yencho, George Craig, Ph.D., Assistant Professor, Horticultural Science
Yim, Man-Sung, Ph.D., Assistant Professor, Nuclear Engineering
York, Alan Clarence, Ph.D., Professor, Crop Science
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Zhang, Daowen, Ph.D., Assistant Professor, Statistics
Zhang, Zhibo, Ph.D., Assistant Professor, Electrical and Computer Engineering
Zia, Paul Zung-Tch, Ph.D., Professor Emeritus, Civil Engineering
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Zimmer, Catherine Roberts, Ph.D., Associate Professor, Sociology and Anthropology
Zingraff, Matthew Thomas, Ph.D., Professor, Sociology and Anthropology
Zobel, Bruce John, Ph.D., Professor Emeritus, Forestry
Zonderman, David A., Ph.D., Associate Professor, History
Zomer, Paul Steffen, Ph.D., Adjunct Associate Professor, Horticultural Science
Zorowski, Carl Frank, Ph.D., Professor Emeritus, Mechanical and Aerospace Engineering
Zublena, Joseph P., Ph.D., Professor, Soil Science
Zuckerman, Gilroy Joel, Ph.D., Associate Professor, Accounting

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History of the University of North Carolina

In North Carolina, all the public educational institutions that grant baccalaureate degrees are part of the University of North Carolina. North Carolina State University is one of 16 constituent institutions of the multi-campus state university.

The University of North Carolina, chartered by the N.C. General Assembly in 1789, was the first public university in the United States to open its doors and the only one to graduate students in the eighteenth century. The first class was admitted in Chapel Hill in 1795. For the next 136 years, the only campus of the University of North Carolina was at Chapel Hill.

In 1877, the N.C. General Assembly began sponsoring additional institutions of higher education, diverse in origin and purpose. Five were historically black institutions, and another was founded to educate American Indians. Several were created to prepare teachers for the public schools. Others had a technological emphasis. One is a training school for performing artists.

In 1931, the N.C. General Assembly redefined the University of North Carolina to include three state-supported institutions: the campus at Chapel Hill (now the University of North Carolina at Chapel Hill), North Carolina State College (now North Carolina State University at Raleigh), and Woman's College (now the University of North Carolina at Greensboro). The new multi-campus University operated with one board of trustees and one president. By 1969, three additional campuses had joined the University through legislative action: the University of North Carolina at Charlotte, the University of North Carolina at Asheville, and the University of North Carolina at Wilmington.

In 1971, the General Assembly passed legislation bringing into the University of North Carolina the state's ten remaining public senior institutions, each of which had until then been legally separate: Appalachian State University, East Carolina University, Elizabeth City State University, Fayetteville State University, North Carolina Agricultural and Technical State University, North Carolina Central University, the North Carolina School of the Arts, Pembroke State University, Western Carolina University, and Winston-Salem State University. This action created the current sixteen-campus University. (In 1985, the North Carolina School of Science and Mathematics, a residential high school for gifted students, was declared an affiliated school of the University).

The UNC Board of Governors is the policy-making body legally charged with "the general determination, control, supervision, management, and governance of all affairs, of the constituent institutions." It elects the president, who administers the University. The 32 voting members of the Board of Governors are elected by the General Assembly for four-year terms. Former board chairmen and board members who are former governors of North Carolina may continue to serve for limited periods as non-voting members emeriti. The president of the UNC Association of Student Governments, or that student's designee, is also a non-voting member.

Each of the 16 constituent institutions is headed by a chancellor, who is chosen by the Board of Governors on the president's nomination and is responsible to the president. Each institution has a board of trustees, consisting of eight members elected by the Board of Governors, four appointed by the governor, and the president of the student body, who serves ex-officio. (The NC School of the Arts has two additional ex-officio members.) Each board of trustees holds extensive powers over academic and other operations of its institution on delegation from the Board of Governors.

University Patent and Copyright Procedures

North Carolina State University is dedicated to teaching, research and extending knowledge to the public.

It is the policy of the University to carry out its scholarly work in an open and free atmosphere and to publish results obtained there from freely, limited only by a short time delay in cases in which this is necessary to prepare and file applications. Patentable inventions sometimes arise out of the research activities of its faculty, staff and students which are carried out wholly or in part with University facilities. As a public service institution, the University has an interest in assuring the utilization of such inventions for the public good. Protection must be provided for at least some of these inventions through patents and the licensing thereof to encourage their development and marketing. Patents and their exploitation, however, represent only a small part of the benefits accruing from either publicly or privately sponsored research.

A portion of the research conducted by the University is supported by government and a portion by private industry. Service to the public, including private industry, is an integral part of the University's mission. As a public institution, the University, in its agreements with private industry or other private organizations, must keep the interests of the general public in view. The rights and privileges set forth in cooperative agreements or contracts, with respect to patents and copyrights developed as a result of research partly or wholly financed by private parties, must be fair and just to the inventor(s), the sponsor and the public. Research should be undertaken by the University under support from private parties only if it is consistent with and complementary to the University's goals and responsibilities to the public.

SECTION 100--Purposes:

The North Carolina State University Patent and Copyright Procedures are designed to implement the Patent and Copyright Policies of The University of North Carolina. The procedures incorporate the interests of the faculty, staff, *and students*, the institution, and the sponsors of research, because in many cases those interests are congruent in desiring to encourage innovation and assure broad dissemination of the results of research. These procedures are designed to stimulate and recognize creativity among the faculty, staff, and students, and to establish an institutional process that is flexible enough to accommodate the different types of research and patentable work conducted at a comprehensive research university such as NC State. Equity and fairness are goals of the procedures in all respects, not only in the distribution of royalty, but also in recognition. Finally, these procedures should provide an efficient and timely mechanism for reaching a decision about patenting with a minimum involvement of the inventor's time so that he or she may continue to be productive in the laboratory and classroom. To this end the University employs a patents administrator whose duties include providing assistance to faculty, staff *and students* in matters related to inventions.

SECTION 200--Ownership:

1. As defined by the Patent and Copyright Policies of the Board of Governors of The University of North Carolina, to which these Procedures are expressly subject, NC State University has an interest in all inventions of University personnel, *including students*, that are conceived or first actually reduced to practice as a part of or as a result of: (a) University research; (b) activities

within the scope of the inventor's employment by, or official association with, the University; and (c) activities involving the use of University time, facilities, staff, materials, University information not available to the public, or funds administered by the University.

2. Faculty, staff, *and students*, whose inventions are made on their own time, outside the scope of their employment or association with the University and without University facilities, materials, or resources and which inventions are, therefore, their exclusive property as specified by the Patent and Copyright Policies, may submit their invention to the University for possible patenting and/or commercial exploitation and management under terms to be agreed upon by the inventor and the University.

3. The provisions of the NC State Patent Procedures are subject to any applicable laws, regulations or specific provisions of the grants or contracts which govern the rights in inventions made in connection with sponsored research.

4. Under the terms of certain contracts and agreements between NC State and various agencies of government, private and public corporations, and private interests, NC State is or may be required to assign or license all patent rights to the contracting party. NC State retains the right to enter into such agreements whenever such action is considered to be both in its best interest and in the public interest. Ordinarily, the University will not agree to grant rights in future inventions to private corporations or businesses except as set forth in these procedures.

5. All faculty, staff *and students* engaged in University related or sponsored research shall sign a Patent Agreement.

6. *Students who are pursuing only non-research related studies shall not be obligated to sign an NC State Patent Agreement. However, if the student should make an invention which is, or may be, subject to University ownership in accordance with the Patent and Copyright Policies, the student shall disclose the invention to the University as provided under these Procedures and the University, together with the student, shall determine an equitable resolution of ownership rights.*

SECTION 300—Responsibilities of NC State Personnel (*Including Students*):

1. NC State personnel who, either alone or in association with others, make an invention in which NC State has or may have an interest shall disclose such inventions to the Vice Chancellor for Research. The Vice Chancellor for Research will promptly acknowledge receipt of disclosures and will distribute the disclosures to the Intellectual Property Committee for consideration at its next meeting.

2. For any invention in which the University has an interest, the inventor, upon request of the Vice Chancellor for Research shall execute promptly all contracts, assignments, waivers or other legal documents necessary to vest in the University or its assignees any or all rights to the invention, including complete assignment of any patents or patent applications relating to the invention.

3. NC State personnel may not: (a) sign patent agreements with outside persons or organizations that may abrogate the University's rights and interests either as stated in the Patent Policies or as provided in any grant or contract funding the research which led in whole or in part to making the

invention, nor (b) without prior authorization, use the name of the University or any of its units in connection with any invention in which the University has an interest.

4. All faculty teaching courses in which students do work that may lead to patentable inventions should inform the students of the existence of the NC State Patent and Copyright Policies and of these Procedures.

SECTION 400--Suggested Procedures For Record-Keeping:

I. U.S. patent practice places a premium on witnessed records when two or more parties claim the same invention. The date the idea occurred (the "conception") and the date it was put into practice form ("reduced to practice") are vital. Equally important in the eyes of the U.S. Patent Office is the "diligence" shown by contending inventors. They must prove that they regularly pursued work on the invention, documenting their efforts on a day-by-day basis. The intent of U.S. patent laws is to recognize the first inventor; the one who originated the idea. Under these laws, the first to conceive and reduce to practice will receive a patent if his records bear out his claims; the first to conceive and the last to reduce to practice may win if his records show diligence.

2. The careful recording of ideas and laboratory data is a matter of routine for industrial researchers. Each entry is complete and up-to-date, signed and witnessed; a legal record of the day's work. Record-keeping is not nearly so simple for the academic investigator, for he or she may work at odd hours or on weekends; may be closeted in a laboratory, an office or at home; and often lacks easy accessibility to suitable witnesses. Still, the keeping of a witnessed laboratory notebook is advisable. Additionally, such records can serve as valuable repositories of new ideas.

SECTION 500-The Handling of a Disclosure:

1. When faculty, *students* or staff members make an invention, it shall be their responsibility to discuss their discovery or invention with the Department Head at which time the possibility of exploring patenting should be considered. *Students should first discuss an invention with their instructor, who shall assist them in further discussion within the University.* The Director of Technology Administration is available to discuss possible inventions and to assist faculty, staff and students in the preparation of disclosures. If the invention appears to be a matter that should be considered for patenting, the inventor(s) should prepare a disclosure utilizing guidelines for invention disclosures which can be obtained for the Director of Technology Administration. The Department Head should transmit the disclosure through the Dean of his School to the Vice Chancellor for Research for consideration by the Intellectual Property Committee.

2. Upon receiving a disclosure, the Chairman of the Intellectual Property Committee may refer the disclosure to one of several technical advisory committees to the Intellectual Property Committee. Technical advisory committees will be appointed by the Vice Chancellor for Research and will be composed of faculty and staff who are knowledgeable and experienced in broad disciplinary or cross-disciplinary areas. These individuals will be asked to review the disclosure from the point of view of whether or not, based on their knowledge, they believe the invention, if patented, would be a strong, viable, commercial product that would have a large market. The technical advisory committee in each area will meet prior to each Intellectual Property Committee meeting if they have any disclosures presented to them, and will discuss the disclosures and make

to the Intellectual Property Committee, prior to its meeting, one of the following recommendations:

- A. That the disclosure has significant commercial possibilities.
 - B. That the disclosure does not appear to have significant commercial possibilities.
 - C. That the technical advisory committee could not determine, based on its knowledge, whether or not the disclosure has significant commercial possibilities.
3. The Intellectual Property Committee will review each written disclosure promptly. The inventor or a representative shall be allowed to examine all written materials submitted to the Committee in connection with the disclosure and to make a written and oral presentation to the Committee. The Committee will decide on a disposition of the invention to secure the interests of the University, the inventor, the sponsor, if any, and the public. Its decision may include, but is not limited to, one or a combination of the following:
- A. To submit the disclosure for review by a patent or invention management firm or agent;
 - B. To make inquiries of potential licensees that may have an interest in the invention, including the financing of a patent application, where applicable;
 - C. To conduct a patent search concerning the patentability of the disclosure;
 - D. To apply for a patent with University resources (an option with limited application because of financial constraints);
 - E. To release University rights to the inventor subject to an agreement to protect the interests of the University, the sponsor, if any, and the public, including an obligation to pay to the University a percentage of future royalties or profits in cases where it is necessary to recognize the University's contribution;
 - F. To dedicate the invention to the public;
 - G. To waive further University interest in the invention.
4. Normally, within four weeks of the receipt of the disclosure, the inventor will be notified in writing of the decision of the Committee on (a) the equities involved including financial participation, (b) whether the University plans to file a patent application, or (c) whether the University will accept assignment of the invention for patenting, licensing and/or commercial handling as applicable. If the University chooses not to file a patent application for an invention in which it has rights, or not to license the invention, or not to dedicate it to the public, upon the inventor's written request the invention, at the Committee's discretion, may be released in writing to the inventor, with the permission of the sponsor, if any.
5. In those cases in which the University has obtained a patent without obligation to sponsors, if no arrangement has been made for commercial development within five years from the date of the

issuance of the patent, the inventor(s) may request in writing an assignment of the University's patent rights. The Intellectual Property Committee will promptly either grant the request or advise the inventor of the University's plans for the development of the invention.

SECTION 600--Royalty:

1. NC State shall share with the inventors revenue it receives from patents or inventions. As noted in Section 200 (4), specific provisions of grants or contracts may govern rights and revenue distribution regarding inventions made in connection with sponsored research; consequently, revenues the University receives from such inventions may be exclusive of payments of royalty shares to sponsors or contractors.
2. The gross royalty revenues (net amount received by the University if there is a specific agreement in a grant or contract with a sponsor) generated by a patent or invention shall be the basis upon which the inventor's royalty is calculated. Unless otherwise agreed, the inventor's share of royalty revenues shall be 25% of the gross revenue. In the case of co-inventors, the 25% of gross revenue shall be subdivided equally among them, unless the inventors, with the concurrence of the Intellectual Property Committee, determine a different share to be appropriate. Applicable laws, regulations or provisions of grants or contracts may, however, require that a lesser share be paid to the inventor. In no event shall the share payable to the inventor or inventors in the aggregate by the University be less than 15% of gross royalties received by the University.
3. To the extent practicable and consistent with State and University budget policies, the remaining revenue received by the University on account of an invention will first be applied to reimburse the University for expenses incurred by it in obtaining and maintaining patents and/or in marketing, licensing and defending patents or licensable inventions and the remainder will be dedicated to research purposes that may include research in the inventor's department or unit, if approved by the Chancellor upon recommendation of the Intellectual Property Committee.

SECTION 700--Inventor Requests for Waiver of University Rights:

1. If an inventor believes that the invention was made outside the general scope of his or her University duties, and if the inventor does not choose to assign the rights in the invention to the University, he or she shall, in the invention disclosure, request that the Intellectual Property Committee determine the respective rights of the University and the inventor in the invention and shall also include information on the following points:
 - A. The circumstances under which the invention was made and developed;
 - B. The employee's official duties at the time of the making of the invention;
 - C. The inventor's intention to request an acknowledgment that the University has no claim if such request is deemed appropriate;
 - D. The extent to which the inventor is willing voluntarily to assign domestic and foreign rights in the invention to the University if it should be determined that an assignment of the invention to the University is not required under the Patent and Copyright Policies;

E. The inventor's intention to request that the University prosecute a patent application if it should be determined that an assignment of the invention to the University is not required under the Patent and Copyright Policies.

SECTION 800--Publication and Public Use

1. North Carolina State University strongly encourages scholarly publication of the results of research by faculty and students. Though the Patent and Copyright Policies do not limit the right to publish, except for short periods of time necessary to protect patent rights, publication or public use of an invention constitutes a statutory bar to the granting of a United States patent for the invention unless a patent application is filed within one year of the date of such publication or public use. Publication or public use also can be an immediate bar to patentability in certain foreign countries.

2. In order to preserve rights in unpatented inventions, it shall be the duty of the inventor, or of his or her supervisor if the inventor is not available to make such report, to report immediately to the Vice Chancellor for Research any publication, submission of manuscript for publication, sale, public use, or plans for sale or public use, of an invention, if a disclosure has previously been filed. If an invention is disclosed to any person who is not employed by the University or working in cooperation with the University upon that invention, a record shall be kept of the date and extent of the disclosure, the name and address of the person to whom the disclosure was made, and the purpose of the disclosure.

After disclosure to the Intellectual Property Committee, the inventor shall immediately notify the Vice Chancellor for Research of the acceptance for publication of any manuscript describing the invention or of any sale or public use made or planned by the inventor.

SECTION 900--Contractual Arrangements:

1. North Carolina State University will follow Federal Regulations with respect to election of title in contracts and grants with Federal agencies.

2. The University normally reserves the right to ownership of patents on inventions arising out of research supported in whole or in part by grants or contracts with non-governmental organizations or firms. Contracts or agreements which are entered into between the University and such organizations or agencies should contain clauses setting forth such a reservation unless deviations there from are requested by the sponsor and approved by the Vice Chancellor for Research. In the interest of fair treatment to the sponsor in consideration for an investment and in the interest of discharging the University's obligation to the public in the application of its facilities and employee time and talent, special provisions may be negotiated by the Vice Chancellor for Research in such non-government sponsored contracts on options such as the following:

A. The University will retain rights to patents arising out of such sponsored research but, if a significant portion of the research costs are borne by the sponsor, including direct costs, the sponsor may be assured a non-exclusive, non-assignable license at a most favorable royalty rate for the use of the patent.

B. Other patent licensing alternatives may be negotiated in the research contract based on factors which will promote effective and expeditious transfer of the technology. Research sponsors are encouraged to seek guidance from the Office of the Vice Chancellor for Research.

C. In order to protect the potential patent interests of both parties in such contracts in which the sponsor is accorded patent rights, the following procedure may be specified:

"When in the course of the sponsored research project the investigator or investigators conceive or reduce to practice some discovery which appears to be patentable, then the inventor(s) will immediately inform the sponsors and the University of such discovery and will, for a specified period as negotiated (normally three months but in any case not more than twelve months), make available to the sponsor all pertinent information and disclosures which may be required for the development of an appropriate patent application. During this period, the investigators agree not to disclose this material to the public and agree to cooperate in the sponsor's effort to secure the patent. At the end of this agreed period, the investigators and the University will be free to proceed with publications and making public such other documents as they may choose. With the exception of the above mentioned agreed period, the University will operate industry sponsored contracts in the normal manner with no other special considerations being given to the sponsor. Under no circumstances will the sponsor have the right to prevent the publication of material or information derived during the conduct of the program or as a result thereof other than for the agreed period indicated above."

Prior written agreement of the investigators involved in research investigations to be carried out under these conditions must be secured by the University to enable the University to discharge its agreed obligations under such a contract.

SECTION 1000—Patent Management and Administration:

1. North Carolina State University recognizes that the evaluation of inventions and discoveries and the administration, development and processing of patents and licensable inventions involves substantial time and expense and requires talents and experience not ordinarily found among its faculty and staff; therefore, it employs the Director of Technology Administration to provide assistance. The University may contract with outside agents for certain services. It may enter into a contract or contracts with an outside organization covering specific inventions or discoveries believed to be patentable and patents developed there from or covering all such inventions, discoveries and patents in which the University has an interest. The University may manage an invention using its own resources.

2. The Chancellor shall appoint a Intellectual Property Committee consisting of no fewer than three members. The Vice Chancellor for Research shall serve as Chairman of the Committee. The Committee shall review and recommend to the Chancellor or the Chancellor's delegate changes in these Procedures, decide upon appropriate disposition of invention disclosures, resolve questions of invention ownership, recommend to the Chancellor the expenditure of invention royalties, and make such recommendations as are deemed appropriate to encourage disclosures and to assure prompt and effective handling, evaluation, and prosecution of invention opportunities and to protect the interests of the University and the public. The Director of Technology Administration shall serve as staff for the Committee and shall attend all meetings.

SECTION 1100—Copyright Procedures:

1. As a general rule, all rights to copyrightable material are the property of the author. The distribution or royalties, if any, is a matter of arrangement between the author and his or her publishers or licensees. Different treatment may be accorded by the University in case of specific contracts providing for an exception, in cases where the University or sponsor may employ personnel for the purpose of producing a specific work, where different treatment is deemed necessary to reflect the contribution of the institution to the work, as in the case of software or audiovisual material, or where a sponsored agreement requires otherwise. All agreements concerning copyright ownership should be in writing and should be signed by the parties and approved by the Vice Chancellor for Research prior to the commencement of the work.
2. An institute, center, or other unit of the University that is itself a publisher and that engages faculty members and other employees to write for publication by that unit as a part of their professional duty or produce other copyrightable materials, such as audiovisual materials or computer software, may, subject to the approval of the Vice Chancellor for Research, adopt rules providing that copyright on materials prepared by such faculty members and other employees in the course of their professional work for that unit vests in the University and not in the author.
3. Guidelines and procedures for determining faculty, staff *and student* ownership of computer software were adopted by the NC State Board of Trustees, effective July 1, 1987, and are available from the Office of the Vice Chancellor for Research or the Office of Technology Administration, Room 1 Holladay Hall.

Policy on Illegal Drugs

The policy on illegal drugs was adopted by the North Carolina State University Board of Trustees on April 16, 1988 and can be found in the Student Code of Conduct and other publications including the Official Bulletin, the Student Handbook, the Faculty Handbook, the Advisers' Handbook and the Human Resources newsletter.

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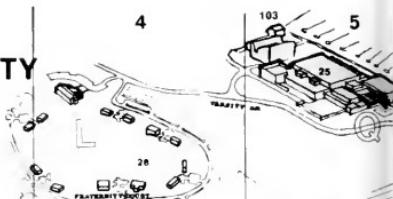
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NORTH CAROLINA STATE UNIVERSITY

F



E

Access Key

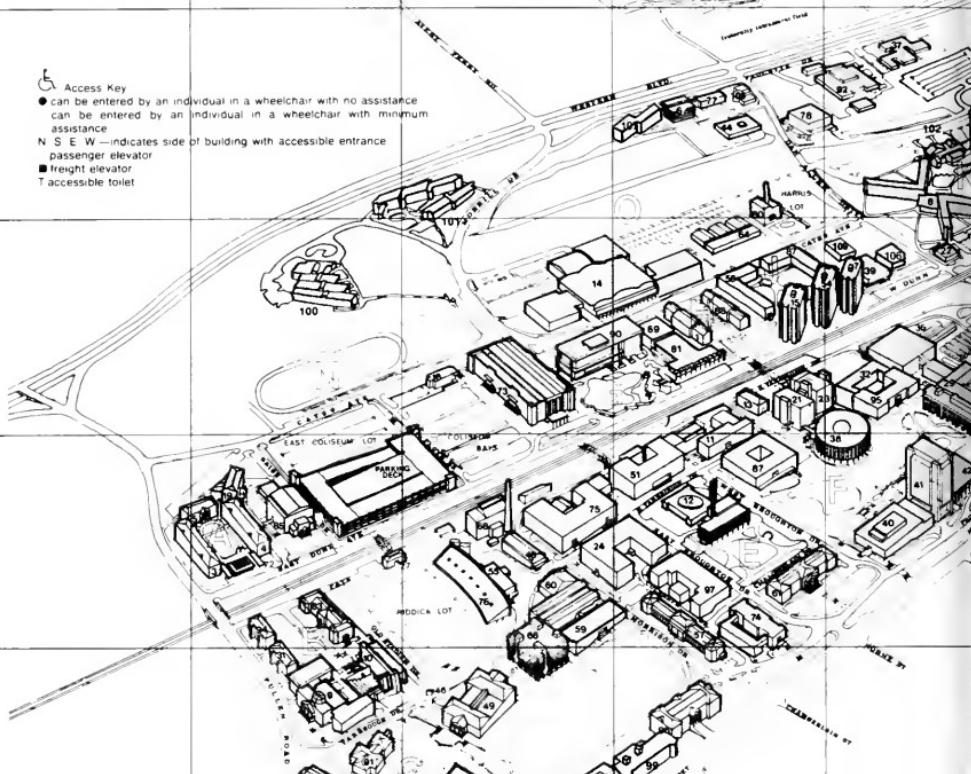
- can be entered by an individual in a wheelchair with no assistance
- can be entered by an individual in a wheelchair with minimum assistance

N S E W—indicates side of building with accessible entrance
passenger elevator

■ freight elevator

T accessible toilet

D

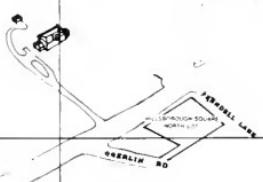


C

B

A

N



ACCESS	NO.	BUILDING NAME
● N	1	Alexander Residence Hall
● N	2	Alumni Memorial Building
● N	3	Bagwell Residence Hall
● N	4	Becton Residence Hall
● N	5	Bell Residence Hall
● N	6	Biltmore Hall
● N	7	Bowen Residence Hall
● N	8	Bragaw Residence Hall
● N	9	Brooks Hall
● N	10	Kamphoefner Hall
● N	11	Broughton Hall
● N	12	Burlington Engineering Labs
● N	13	Burdette of Mines
● N	14	Carmichael Gymnasium
● N	15	Carrill Residence Hall
● N	16	Case Athletics Center
● N	17	Central Stores
● N	18	Chancellor's Residence

1

2

3

4

5

ACCESS	NO.	BUILDING NAME	GRID	CODE
● W	19	Clark Hall Infirmary	2-C	
S ■	20	Clark Laboratories	5-D	CL
· N	21	Cot Hall	4-D	CDX
N T	22	West Dom Building	5-D	
N	23	Dabney Hall	4-D	DAB
● W ■	24	Dalebs Hall	4-C	DAN
● W T	25	McKimmmon Extension Continuing Education Center	5-F	
	26	Farm Unit 5	6-F	
N	27	Field House	2-C	
	28	Fraternity Court	4-F	
S ■	29	Gardner Hall	5-D	GA
● N T	30	Boston Hall	5-D	
	31	Gold Residence Hall	2-C	
	32	Willow Hall Add-on	2-C	
	33	Greenhouse - Biological Sciences	5-D	AGH
	34	Greenhouse - Horticulture	5-D	BSG
	35	Greenhouse - 840 Method Rd	8-F	HGH
	36	Greenhouse - Plant Pathology	5-D	PPG
E	37	Griffiths Animal Health Lab	5-E	GHL
N T	38	Harrison Hall	5-D	HA
	39	Heirs Hall	5-D	
W	40	D H Hill Library-Original Wing	5-C	DHL
W T	41	D H Hill Library-Book Stack Tower	5-C	
N S	42	D H Hill Library-Erdahi-Cloyd Wing	5-C	
	43	North Campus Bookshop	5-G	
● N T	43	Hillsborough Building	5-C	HLB
W	44	Hodges Wood Products Lab	4-E	HWP
	45	Holiday Hall	2-B	
	46	Information Center, Visitor Parking	3-B	
BS	47	Krigore Hall	6-D	KI
A	48	Laundry/Copy Center	3-C	
BR	49	Leazar Hall	3-B	LEZ
BU	50	Lee Residence Hall	5-E	
CG	51	Magee Hall	1-C	MN
	52	E King Village (17 Apt Bldgs A-O)	7-F	
	53	Memorial Tower	3-A	
	54	Metcalf Residence Hall	4-D	
	55	Morris Building	3-C	
	56	Nelson Hall	6-D	N
	57	1911 Building	4-C	

ACCESS	NO.	BUILDING NAME	GRID	CODE
E	58	Owen Residence Hall	4-D	
W	59	Paga Hall	3-C	PA
	60	Park Shops	3-C	PS
S	61	Patterson Hall	4-C	PT
● E	62	Peeler Hall	3-B	
	63	Physical Plant Maint. Center	7-E	
	64	Physical Plant Shops (Armory)	4-D	
E	65	Photofon	5-D	PHY
	66	Poe Hall	3-C	PDE
● N	67	Polk Hall	4-C	PK
	68	Power Plant	3-C	
S	69	Price Music Center	4-D	PMC
● W T	70	Primrose Hall	3-B	
	71	Print Shop/University Graphics	6-E	
● E	72	Quad, Snack Bar	2-C	
E T	73	Wm. Neal Reynolds Coliseum	3-D	
E	74	Ricks Hall	4-C	RI
N ■	75	Ridick Engineering Labs	3-C	RD
	76	Ridick Stadium	9-C	
E	77	Robertson Wing, Biltmore Hall	4-E	
S	78	Schauf Food Science Building	4-E	SFS
S ■	79	Scott Hall	5-D	SC
	80	Steam Plant	4-E	
E ■	81	NCSU Bookstores	4-D	
	82	Sullivan Residence Hall	6-E	
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N S	85	Thompson Theater/Craft Center	2-C	TT
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	93	Weed Control Laboratories	8-F	
	94	Weich Residence Hall	2-C	
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E ■	97	Winters Hall	4-C	WI
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G	University Student Center Plaza	4-D		
H	Turlington-Alexander Court	4-D		
J	Tucker-Owen Court	4-D		
K	Lee-Sullivan-Bragaw Court	5-E		
L	Fitzgerald Court	4-F		
M	E.S. King Village Court	7-F		
N	Paul H. Derr Track	2-U		
O	Miller Fields	4-E		
P	Davis Field	6-E		
Q	McKimmmon Center Court	5-F		
R	The Big Acre	8-F		
S.	Tennis Courts	6-E		
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Carmichael Lot	3-D			
Coliseum Bays	3-D			
East Coliseum Lot	2-C			
Friendly Drive Lot	6-D			
Harris Lot	4-E			
Hillsborough Building Lots	6-C			
Parking Deck				
Hiddick Lot	3-C			
Sullivan Lots	6-E			
West Lot	6-E			
Additional West Lot Parking	5-E			
Yarbrough Lot	3-C			
Hillsborough Square North	2-A			

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